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## POWER AND GAS

**Devoted to the Conversion, Transmission and Distribution of Energy**

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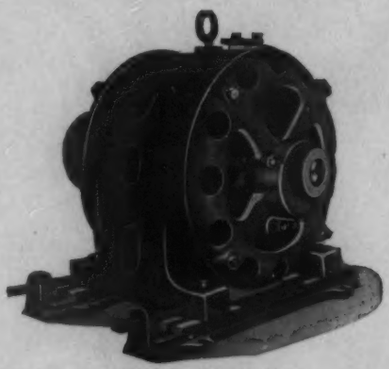

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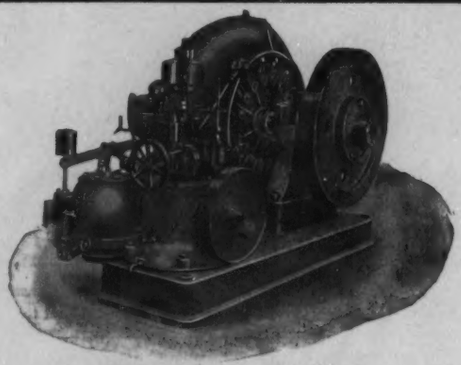

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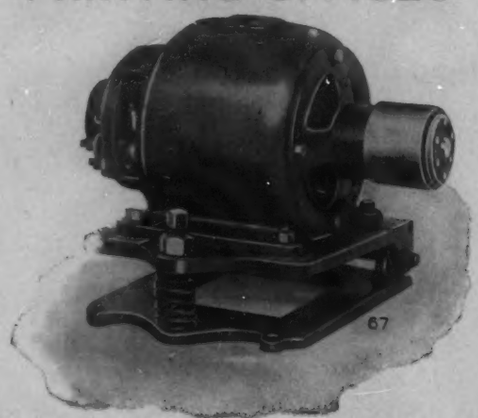

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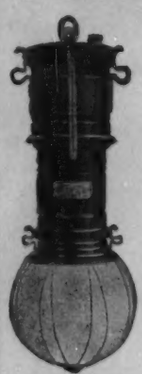

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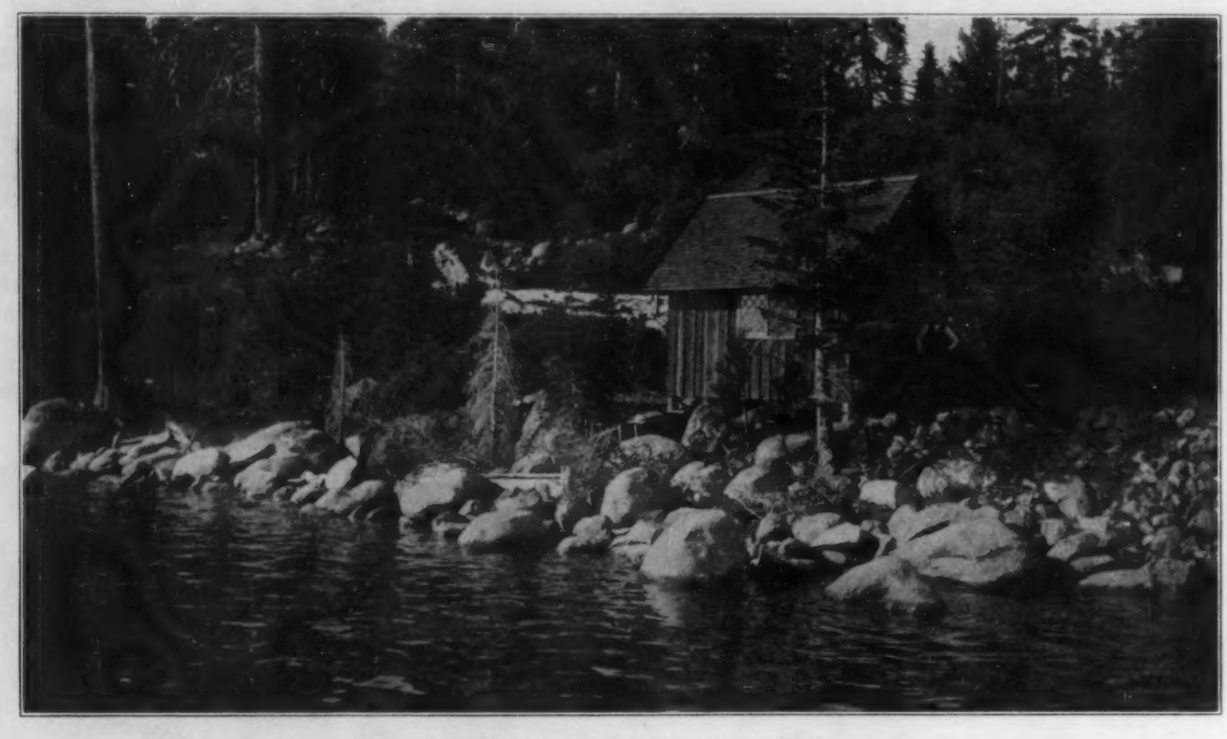
# A MODEL HYDRO-ELECTRIC INSTALLATION

In these days of conservation, we are all interested to know just what can be done with our natural resources. A very unique example of utilizing a small stream of water for the convenience, comfort and economy of its owner is a plant herein described. This installation was purchased and installed by Mr. Harry Babcock on his beautiful country home on the shores of Lake Tahoe, near Tallac, California. The little mountain stream which flows across Mr. Babcock's property has been idling itself away for countless generations, its only usefulness being that of adding its rythmic accompaniment to the already beautiful mountain symphony.



Model Hydroelectric Plant on Shore of Lake Tahoe.

Without in the least detracting from all that nature has done for this ideal summer home, Mr. Babcock has, by harnessing a small percentage of the water flow, placed himself in possession of all the conveniences and comforts of a city home. The accompanying photographs show how he has concealed the pipe line down the mountain side to the small power-house. The reservoir back in the canyon stands at a level of approximately 130 feet above the water-wheel, and he thus has ample pressure to carry the heaviest loads he can place upon the generator.

The power-house itself is complete in every detail, consisting of a Pelton impulse water-wheel, which is belted to a 4 k. w., 1350 r. p. m., constant speed, Westinghouse direct current generator.

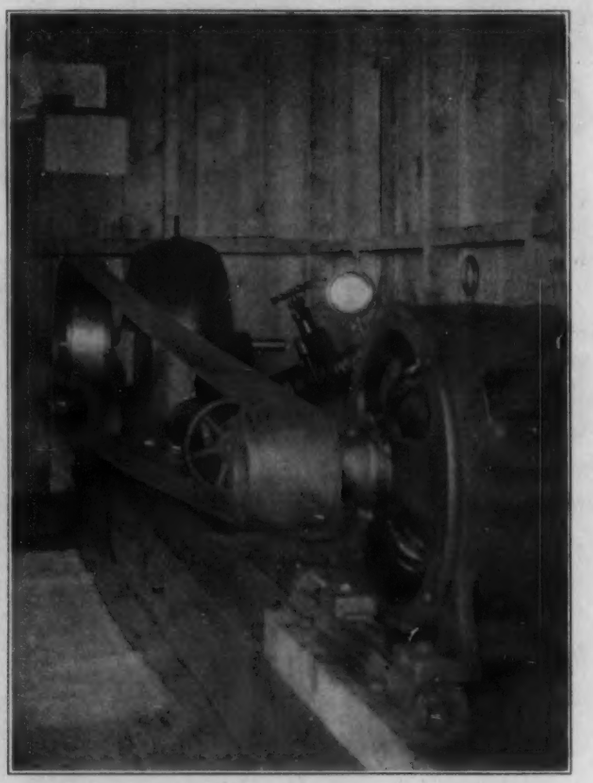
The hydraulic conditions under which this small plant operates involve a total head of 124 feet and a pipe line consisting of approximately 723 feet of 6-inch and 722 feet of 5-inch pipe. This, together with

the water motor, was furnished by the Pelton Water-Wheel Company. The pipe line is the ordinary double riveted, sheet steel piping, dipped inside and out in asphaltum composition and provided with slip-joints. In laying the pipe great care was exercised in driving the joints so that the rivets were not started. To assist in making a perfect joint a gasoline torch was employed for heating the large ends of the slip-joint sections. On cooling, the pipe naturally contracted, after which it was painted with an asphaltum preparation, and a perfect joint resulted. Such care was exercised that notwithstanding the great length of the pipe line, practically no leakage resulted, merely the ordinary sweating observed on all such lines.

Pipe Line.

In addition to conveying water for the use of the wheel in the power-house, a branch pipe serves the dwelling, besides affording fire protection by means of hydrants located at advantageous positions. The power-house, being located at some distance from the dwelling, wherein is located the switchboard, the main stop gate valve was placed in the pipe line at a point some 200 feet from the dwelling. The gate valve is operated by a system of levers and a wire cable terminating in a winding drum. By this means the wheel may be started or stopped and hand regulation obtained without the necessity of journeying to the power house for this purpose.

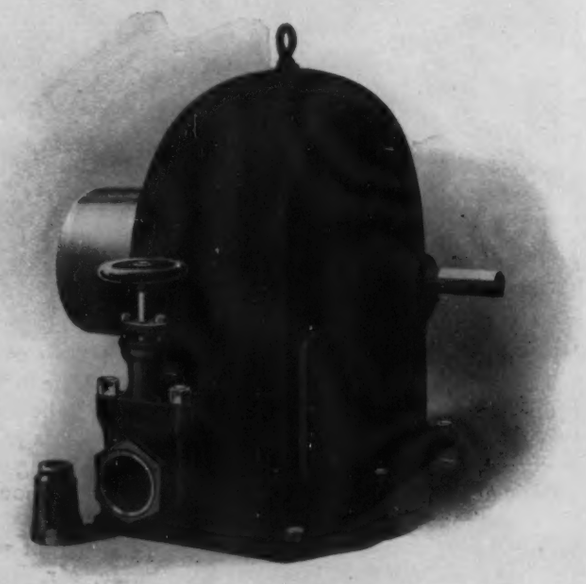
Belted to the electric generator is a Pelton 24-inch type "C" motor of similar design to the illustration herewith, but equipped with a regulating nozzle which is manually operated. As the entire number of lights



Generator.

installed do not burn continuously, the needle nozzle is set to carry the maximum night load. Then as the load gradually drops a solenoid device cutting in and out a resistance, maintains a constant load on the wheel, thus insuring uniform speed.

This regulator consists of a group of resistances, which are shunted across the main terminals of the generator, through solenoid switches. These solenoids are placed in series with the main load circuits, and are designed in such a way that if the load, or any part of it, is suddenly removed, the switches will close and shunt in an equivalent amount of resistance, so

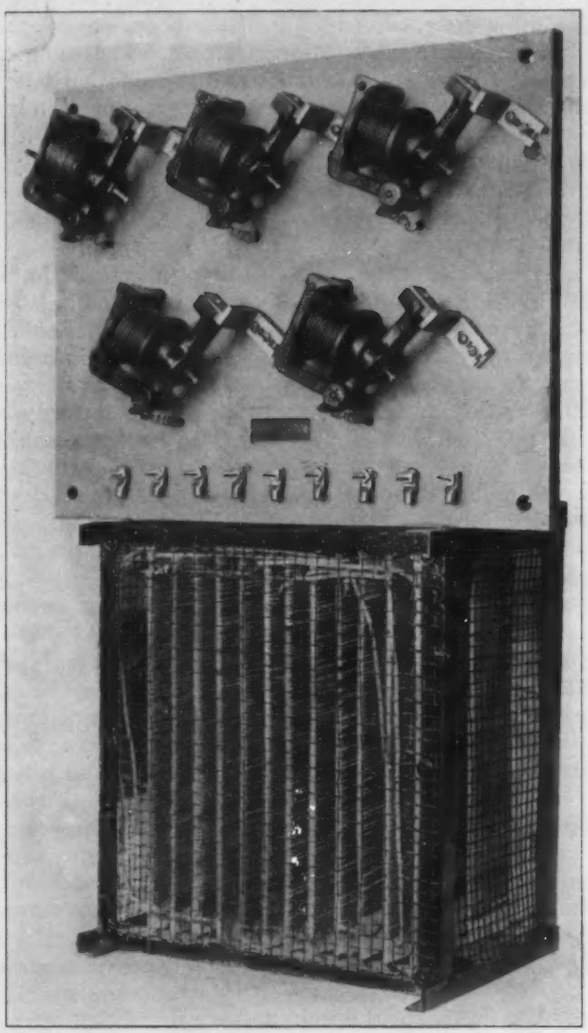


Pelton Water Wheel.

that an approximately constant load is kept upon the generator at all times.

The distribution circuits extend some 200 feet from the power-house to the residence and out on the wharf, over the edge of the lake, and along the various walks of Mr. Babcock's spacious grounds.

The generator is controlled by a standard panel, on which is mounted a voltmeter, an ammeter, a main switch, field rheostat, and pilot lamp, as well as distribution switches. Mr. Babcock has also installed a voltmeter in his residence, so that it is possible for



Regulator.

him to start up the plant from the hydraulic valve control, above mentioned, and bring the machinery up to the right speed without going near the power-house.

A small isolated power plant of the above description possesses many advantages over gasoline engines and other forms of prime movers, because of the simplicity of the water-wheel mechanism and the benefits derived from having a constant water pressure available at the dwelling for fire protection and the installation of fountains about the grounds of the dwelling. The cost of such a water-power installation is nominal, while the maintenance charges are practically negligible, no skilled attendance of any sort being necessary.

## SCIENTIFIC BUSINESS METHODS.[1]

BY HARRY N. TOLLES.

We are all of us in business for a purpose and the topic of economy is one that I believe is a paramount question that every man is interested in, so far as his own energies are concerned. I want to talk to you on the question of economy. There are fellows in the business world who revolve round and round the same thing and never seem to get anywhere. The other fellow comes in and is promoted. I know an industry in this city, one of the biggest of its kind in the country. I went in there one day to confer with a man, and I found that his superintendent was, about six or eight years ago, acting as his office boy, and he had been standing still on exactly the same plane all that time.

Now, success and advancement depend upon natural law. There is such a thing in the success problem as the law of truth and principle, which, if followed, can help to make a man successful. I want to first take up the question of determining the value of yourself or anyone in your employ. What is it that determines the value of a man? The value of the individual is equal to that individual, minus the supervision he requires in his work. The less looking after that employe requires, the more valuable he is to you. Take stenographers, for example. I dictate a letter. One girl makes a few chicken tracks across the page, and writes the letter. It comes to me misspelled, not properly punctuated, paragraphed, and so forth, and I have to make corrections and I have to send it back. She is only a would-be stenographer. Number Two comes to me; I dictate the letter and she writes every word down and does the work properly. She is more valuable than Number One, because she requires less supervision. Number Three comes and I sort my mail and say, "Tell this man we can't do that, or tell this man we had this matter up and we decided this in connection with it." And she will compose that letter. Once in a while there will be a letter I have to compose to her in detail, but she will get that dictation properly. Here comes Number Four. My mail, instead of coming to my desk, goes to her; she opens the mail and she runs through and sees there are certain things she can attend to as well as I can, and she brings me that mail ready for my signature. What is the difference in these four different stenographers? Simply the amount of supervision they require in their work.

Supervision is made necessary in our work because of two little things: errors of omission plus errors of commission. You take the mistakes that you make or your employe makes, things omitted that should be done, things that are done that never should have been done, and you subtract them from the entire work of that individual and you will determine the value of the individual. But if you can go a step further and find out where those mistakes come from and stop the leaks, then you have made progress.

All through life, there is a duality of forces at work. There is the positive and the negative. Light is positive and darkness is its negative; heat is positive and cold is its negative; and so in the mind and in

[1]Address delivered before Technical Conference, International Independent Telephone Association, Dec. 7, 1909.

the body. We have health, positive, and sickness, its negative; strength, a positive, and weakness, its negative. The thinking part of the mind is divided into three parts: the thinking, the feeling and the willing part. In the thinking, we have first, observation. Every idea that ever came into your head or mine came through one of the five physical senses. If it came from without, either we heard it or we saw it, we smelt it, we touched it, or we tasted it. Therefore, it is extremely important that we should train ourselves to be good observers through these five physical senses. Then comes concentration; then comes memory, and judgment is next.

Imagination is the great image-making power of the mind, and there is where man's progress has been made in the last half century, or possibly the last quarter of a century; where the most progress has been made in the telephone business. No invention was ever made by any of you, in your business, until you had the image in your mind. One course of study the business man should pursue is the study of constructive imagination. A premium is put on the man today that trains the imagination and imagines accurately and has the judgment and reason to back it up.

The next function of the mind is the feeling side. One says, "What has feeling to do with business?" I say it has a great deal. Here we have faith, with its doubt; courage, with its fear; loyalty, with its disloyalty; honesty, with its dishonesty. And you can go on with a legion of these. At any rate, there are a great many feeling elements of the mind which must be trained and developed.

Did you ever see an employe make a success of his business, if he doubted he could do it? Was not your company formed because somebody believed in his ability to form it, and then went to work and talked up his belief to get other people to believe in him and in his proposition? Faith is a great asset in the business world. Loyalty is a starting point in the selection of employes. The very first question you should determine in the hiring of an employe is, "Will he be loyal?" If he left the position he has left to come to you because he was disloyal, then look out for him. I believe disloyalty is the first step towards dishonesty; that dishonesty is a step towards theft. How does it work? The fellow says, "Oh, thunder, I am only getting $18 a week and I know I am worth $20 or $25; what's the odds if I do knock off half a day? It's coming to me." Or if the boss is out and he is not supposed to use this telephone service and he uses it for a long distance call, worth fifty cents, he says, "I am entitled to it; it's coming to me." There are a hundred and one ways in which that person can steal a little and not call it stealing at all. It starts from disloyalty.

Now as to the next function of the mind, the will power. It has indecision as a negative, an inaction. Every mistake you and I make, or have ever made, can be traced to some one negative or combination of negatives in ourselves. Remember this. The success of your institution is no more than the sum total of the successes of the individuals in your institution. There can't be a failure from the wrong adding up of a single column of figures; there can't be a failure from the one salesman who goes out and misrepresents and falls down, but it subtracts just that much from the success of your institution. Every mistake is traceable to a negative or some combination of negatives. For instance, suppose it is weakness. That operator comes to the office. She has been out pretty late the night before and has a headache or an attack of indigestion and asks to be excused. It is just as much her business to preserve and keep that health, as to keep any other function of the body or the mind. Health is a harmonious condition of the three parts man has: the body, the mind and the soul. And there is such a thing as a diseased condition of the mind, as well as there is a diseased condition of the body. Suppose it is simply weakness and forgetfulness. The thing for us to do, if we want to increase the value here, is to eliminate that weakness and that forgetfulness and increase the strength and the memory. How can it be done? If this room is full of darkness, what do you do? You simply turn on the lights, of course. A muscle is weak. I exercise that muscle, systematically until it grows. If I don't feed it, it won't grow.

Therefore, there are two things necessary in the development of the faculties of the mind, and also of the physical man. One is proper food and the other is proper exercise. Has a single idea been put into your mind by anybody else since you arrived in the city of Chicago, which has not been proper food for your mind? I believe there is such a thing as poisoning the mind, just as you can poison the body. Anything you hear that does not help you, hinders you, and you cannot afford to alow matters to get into your minds that do not help you. Therefore, let us expose the mind to the best things, the best food.

Now, there are three ways to develop the memory. Remember three simple rules and you can make a gigantic power of that mind of yours. They are the rules for health and for strength. The present school system of today is built up on the principle of cramming the mind. I am not deploring the school system, but there is such a thing as getting so close to educational problems that you cannot see them. Go back to the old Latin meaning of the word education—educt, to draw out—and you can start tomorrow with every employe you have, to, in some way, get in touch with his mind. The thing we are after is the drawing out, the education of the forces of the individual. By doing that, we increase the positives and we decrease the negatives. By decreasing the negatives, we naturally stop the leaks, so to speak, and we decrease the mistakes that occur. This, in turn, decreases the amount of supervision and increases the amount of value. In other words, the value of that individual can be increased by the development of his positive forces.

Now, let us take another step. By the development of the positive body, we get endurance. I don't care where a man works in your concern. He needs to have the principle of endurance trained in him, and the better he can endure the better he can succeed.

In the training of the physical forces of a man, endurance can be prominently mentioned. The fellow who can get into the game and stay in the game is the man of endurance. And as you train the imagination and reason, you get the ability. Hence, you should train the feelings of faith and loyalty and courage and honesty and ambition. Reliability comes next in the

will power after decision and action. We have activity, and I submit to you that the man who has endurance, and the man who is a good thinker, and the man who is reliable, and the man who has action, is the man to go out and be successful, no matter where you put him.

Every person, if he is a normal man, has fifty-two positives. Roosevelt started out lacking health, and he went out on the plains and developed himself into a man of mighty action and strength. Sandow, they tell us, was born a helpless invalid, and yet he became a great giant. The same thing is true of every one of those muscles. I don't mean by that you can achieve an impossibility, but I say it is possible to raise each person just a little, and by the raising of that person just a little you are going to make him a better thinker, a better actor, because you cannot take a step, you cannot move a hand, or say a word, that the mind does not operate. Therefore, if a man would control his words, his acts, his deeds, the thing for him to do is to control his mind.

Salesmanship is the power of persuading people to purchase, at a profit, that which we have to sell. Did you ever analyze the power to persuade? Tennyson says: "Knowledge, reflection and control, these three alone lead to sovereign power."

In every sale there are four factors at work. First, the salesman; second, the customer; third, the thing sold; and last, the sale itself. If you want to develop the salesman, the thing to do is to develop his mental faculties. It is infinitely easier to train and develop a person if he is loyal and wants to get ahead. It is easier to correct the negatives in that person than it is to go out and hire somebody else.

There are various types of customers. You cannot handle them all alike, if you are selling them. While it is true there are no two men alike in this world, all men classify themselves naturally into certain different types and temperaments, and it is folly to attempt to handle one type as you would another. Even the inflection of the voice means something. If you want to influence a man you won't walk ten feet in front of him, or ten feet behind him. No, you will walk right beside him. You must learn to walk mentally with the person to whom you want to make the sale. What you say should fit like cogs in the mind of that customer.

The next thing is the thing sold. Logic is the thing that helps most. Logic is divided into two branches: first, the ability to analyze the proposition; and second, the ability to synthesize it or build it up. In your advertising, you do the same thing. You present your points to your customers, but you find you have a lot of them and those points have to be so small you need to be an expert on the points of your proposition. Then after you get them all laid out, synthesis comes in and you synthesize or arrange those points in logical order. So many fellows go out to sell goods who have just a hazy idea in their minds of what they have to offer.

The last is the sale itself. The branch of science that helps most there is the branch of psychology. Here come attention, interest, desire, and resolve to buy. Every mind comes to each of those four stages every time.

First, attention. If that glass of water is full, you cannot get any more water in it without spilling out some of that. And if you want to get that customer, the thing for you to do is to spill that mind first before you can get your ideas in it. Next, interest; then desire. Interest is only a little more than attention; desire comes from the logical arrangement of your selling points. It is points that sell goods today. The time of the human cyclone, the wind-mill and the talking machine is over. Points sell goods. Then you have got to get resolution. Attention, interest, desire, and resolve to buy. And all through the whole transaction there has got to be a feeling of confidence.

After the sale is made the law of mutual benefit has to operate. No sale is a good sale unless it is clearly advantageous to both buyer and seller and, therefore, satisfaction must result. Satisfaction makes that customer a repeater, and a link in an endless chain to bring more customers to your business.

## NITRATES IN NORWAY.

Supplementing previous articles on the manufacture of air nitrates for fertilizer in Norway, Germany and Niagara Falls, Canada, it is learned from British consular reports that the industry is undergoing rapid expansion in the first-named country, where nearly $15,000,000 will be invested. Though there are vast water powers in the United States running to waste, which could be utilized to produce this article, nothing has yet been done in that line, although this country is buying annually about $15,000,000 worth of Chilean nitrates.

About $6,000,000 has been expended on the works at Notodden and Svaelgfos and the power stations under construction at Rjukan and Vamma. When all the works are completed, at the end of 1910, $14,600,000 will have been spent. A great point in connection with the development of this industry, is that the opportunity has now arisen of opening up several industries in connection with the manufacture of nitrates, such as nitric acid, nitrate of ammonia, nitrate of potash, also sodium nitrate, which last is already being manufactured.

The Nobel syndicate, in conjunction with the Birkeland and Eyde Company, is now concentrating the weak acids, with the assistance of the gas furnaces, to an acid of such percentage as to become an article of transport, and further opportunities have thus been opened for export trade, especially from works with water power that are situated near the seaboard.

It is of interest to note that no coal is used in the production of saltpeter or other products here referred to. It is stated authoritatively that there is no probability for many years to come that the sale of saltpeter produced by the method practiced at the Notodden and Rjukanfos works will be disturbed by competition with Chile saltpeter on the question of price.

When the Rjukan Falls works are fully completed, they and the Notodden works combined will represent 240,000 horsepower, with a production of saltpeter representing an export value of $6,164,000.

The value of the output of nitrates in Norway in 1908 was about $536,000, and the total expenses amounted to $402,000.

# AN ALTERNATING CURRENT CALCULATING DEVICE.

BY F. G. BAUM.

Usually one of the most important questions concerning a system of electrical transmission, transformer, or generator, or any combination of these, is regulation. That is, for a given receiver pressure, by what percentage must the delivered or generated pressure exceed the receiver pressure, not only for unity power-factor but for loads of any power-factor. A simple device will be herein described which will give the regulation of any system *for any load and any power-factor* without making a diagram for each case. To use the device it is only necessary to determine two constants, which are usually given or are easy to determine. To make the explanation simple, let us confine ourselves to a transmission line. We are to determine the regulation for any load and any power-factor; that is, the percentage by which the pressure delivered to the line by the generator must exceed the receiver pressure for *constant receiver pressure.*

Taking the lost pressure as a whole, we are always concerned with three pressures in any case: (1) the receiver pressure, (2) the lost pressure over the line, (3) the pressure delivered to the line. (This is also true for generator or transformer, or any combination of transformer, generator, and line.) The lost pressure is made up, in any practical case, of the resistance pressure and the reactance pressure. When, as is generally the case, we have receiver loads of different power-factors, we get

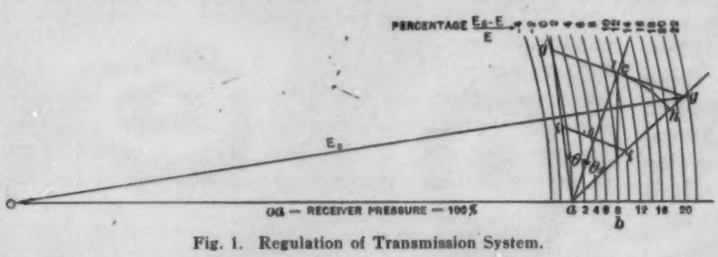



Fig. 1. Regulation of Transmission System.

simpler results if we consider the total receiver current divided into two parts, one the *power component* and the other the *wattless component* of the receiver current, and regard each as flowing separately over the line. If $I$ is the total receiver current and $\theta$ the angle of lag of the receiver current behind the receiver pressure, the power component of the receiver current is $I \cos \theta$, and the wattless component is $I \sin \theta$. (Cos $\theta$ is the power factor of the receiver circuit; for a non-inductive load cos $\theta = 1$, and sin $\theta = 0$.) Let $E = oa$, Fig. 1, represent the receiver pressure. The pressure consumed by the line resistance and reactance due to the power component of the load current is $I \cos \theta \sqrt{R^2 + (Lw)^2}$, in which $R$ is the resistance and $Lw$ is the inductance or reactance of the line. In Fig. 1,

$$ab = I \cos \theta \, R$$

$$bc = I \cos \theta \, Lw$$

Therefore $ac = I \cos \theta \sqrt{R^2 + (Lw)^2}$.

$ab$ is 8% of the receiver pressure; that is, the $I^2R$ loss in line is 8% at full non-inductive load.

$ac$ represents, then, in magnitude and direction, the pressure consumed over the line by the power component of the receiver current. If for a lagging current we make the angle $cag = \theta$ ($\theta$ is the angle by which the receiver current lags behind the receiver pressure), and the angle $acg = 90^0$, then

$$cg = I \sin \theta \sqrt{R^2 + (Lw)^2},$$

as can be proved by simple geometry. That is, $cg$ represents in magnitude and direction the pressure consumed over the line by the wattless component of the receiver current. (If the receiver current leads the receiver pressure by the angle $\theta$, then $cg'$ is equal to the pressure consumed by the wattless component of the receiver current.) It should be particularly noticed that the pressure consumed by the wattless current is at right angles to that consumed by the energy current. Notice also that $ac$ is proportional to the power current, and $cg$ to the wattless current. The true direction of the power current is along $E$, and the wattless current at right angles to $E$,—downward for lagging, upward for leading current. The line $ag$ therefore represents in magnitude and direction the pressure consumed over the line by the total receiver current. Hence $og$ represents $E_0$, the pressure delivered to the line, in magnitude and direction.

$ac$ represents the pressure consumed by *full-load* non-inductive current. Then $ac/2$ will represent half load on line, etc. For half load, and the same angle as before, $E_0$ is given by $oi$. Through $c$, with $a$ as center, a circular arc has been drawn. At *full-load current*, and a power-factor corresponding to the angle $\theta$, the value of $E_0$ is given by $oh$.

With $o$ as center, circular arcs have been drawn through $a$, 2, 4, etc. The radial distance between two successive arcs is 2% of the receiver pressure. We see, as shown by the point $c$, that the regulation of this system for full non-inductive load is 11%; that is, the generator pressure must be 11% higher than the receiver; at *full kilowatt load*, at a power-factor corresponding to the angle $\theta$, the regulation is 21%, as shown by the point $g$; *at full kilovolt-ampere* load, that is, for the same current as before delivered at the same power-factor, the regulation is 19%, as shown by the point $h$.

In Fig. 2 is shown a case for a receiver pressure equal to 10,000 volts (the point $o$ is not shown). $ac$, which represents full load, has been divided into ten equal parts, corresponding to 0·1, 0·2, etc., lines have been drawn at right angles to $ac$. Radial lines making angles corresponding to cos $\theta = 0{\cdot}95$, cos $\theta = 0{\cdot}9$, etc., for lagging and leading currents, have been drawn from $a$. Circular arcs, with the point $a$ as center, have also been drawn through points along $ac$ marked 0·1, 0·2, etc.

The regulation for any load and any power-factor may be determined from the figure. For example, find the regulation at 0·9 *full load* at 0·8 power factor: Go along $ac$ to $c' = 0{\cdot}9$, then along $c'g'$ to the intersection with the line cos $\theta = 0{\cdot}8$. The regulation is seen to be about 21½%. For 0·9 full-load current,

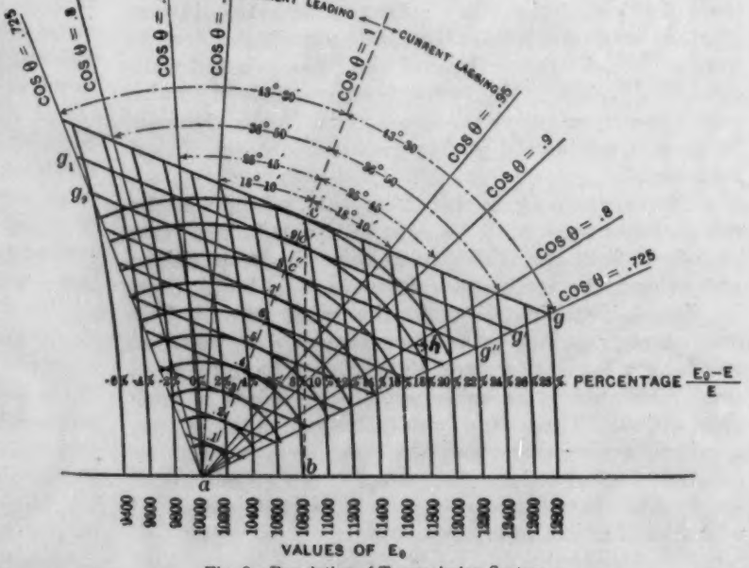



Fig. 2. Regulation of Transmission System.

and the same power-factor, the regulation is 17%. as shown by the point $h$.

It is seen that for any given case it is only necessary to

determine the triangle *abc*; the remainder of the figure is drawn mechanically. The labor of making the drawing for each case may be eliminated if, instead of laying off *oa* to represent a particular receiver pressure, we let it represent any receiver pressure and call this pressure 100%, Fig. 3*a*.

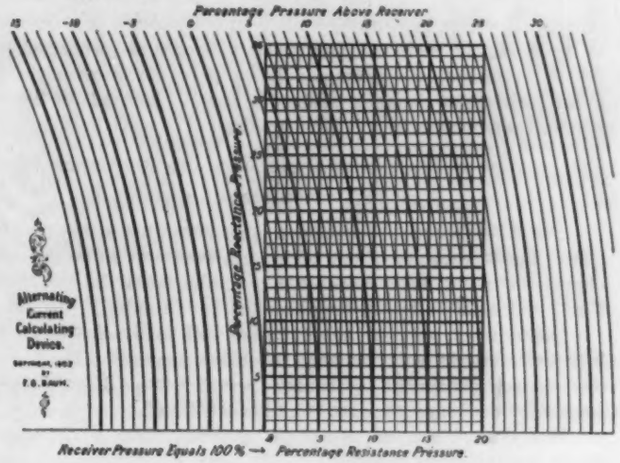

Percentage Pressure Above Receiver
Percentage Reactance Pressure
Alternating Current Calculating Device.
Receiver Pressure Equals 100% → Percentage Resistance Pressure.

Fig. 3a. (*Half size.*) *Printed on cardboard.*

Now all that is necessary is to determine the resistance and reactance pressure in *percentage* of normal receiver pressure for any particular case, and lay them off horizontally and vertically

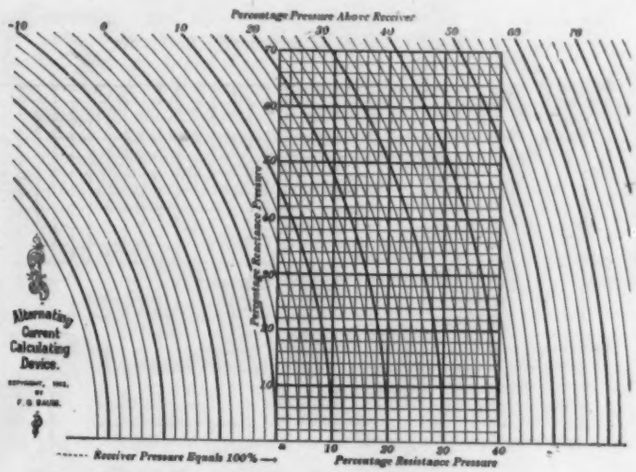



Fig. 3b. (*Half size.*) *Printed on cardboard.*

to obtain the triangle *abc*. For convenience, Figs. 3*a* and 3*b* are made to cover all cases met with in practice. Points along the horizontal represent different values of *ab*, the resistance pressure in percentage of delivered pressure; and points along the vertical, different values of the percentage pressure consumed by reactance. Circular arcs with *o* as center (the point *o* is not shown) have been drawn in Fig. 3*a*. We see that the other lines in Fig. 2, now shown in Fig. 4, always bear the same relation to each other, and in the calculating device these are, therefore, printed on a sheet of transparent celluloid. By placing Fig. 4 on Fig. 3*a* or 3*b*, and fastening at the circles at *a*, so that one may be rotated with respect to the other, we get a device that applies to any case. The distances 0 to 1, 1 to 2, etc., on Fig. 4, are the same as the distances 0 to 1, 1 to 2, etc., on Fig. 3*a*. When the reactance pressure is greater than 35% use Fig. 3*b*.

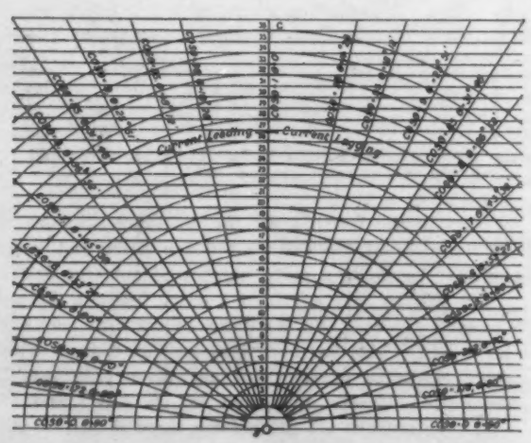


Fig. 4. (*Half size.*) *Printed on transparent celluloid.*

Fig. 5 gives an example of the application to the calculation of the regulation of a line. Here the resistance pressure, or copper loss, equals 7% at full non-inductive load; reactance pressure equals 20% at full non-inductive load.

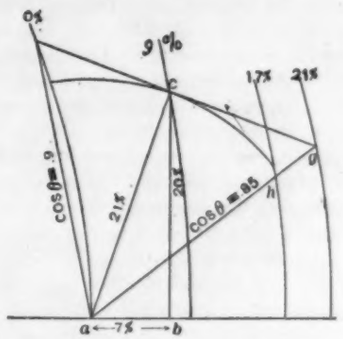



Fig. 5.

*ac* is rotated until it passes through the intersection of 7% and 20%. The number 21 coincides with 20 and 7, therefore the pressure consumed over the line at full non-inductive load is 21%. (When using Fig. 3*b*, numbers along *ac*, Fig. 4, are to be multiplied by 2.) 21 represents full load on line, 10½ will represent half load, etc. The regulation at non-inductive full load is seen to be 9%. For *full kilowatt load* at 0·85 power-factor move along 21 to *g*; regulation equals 21½%. For *full kilovolt-ampere load* at 0·85 power-factor move along 21 to *h*: regulation equals 17%. For equal generator and receiver pressure at full load move along 21 to arc marked 0%. The figure shows that for 0·9 power-factor, for leading current, the receiver pressure would be practically equal to the generator pressure for all loads; that is, the line would be self-regulating.

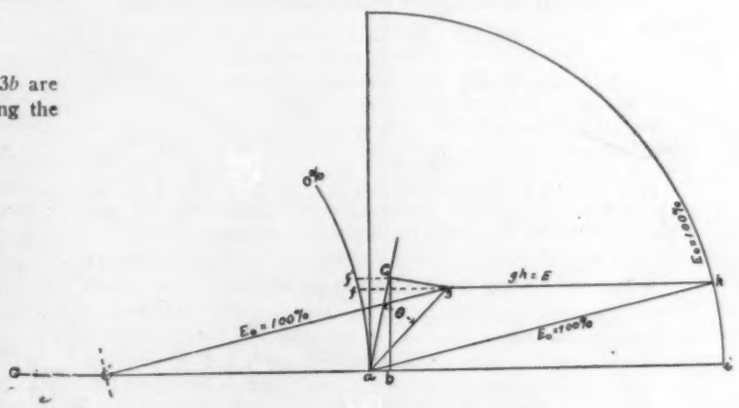



Fig. 6. Determining Drop in Pressure.

Circle *ih* is drawn with *a* as center.
Since $oa = E_0$, $fh = E_0$, $o^1a = gh = E$; $\therefore oo^1 = fg$.

The device may be used to find the receiver pressure when the generator voltage is kept constant. In this problem the generator pressure would be called 100%. Now, for a given current drawn by the receiver at a given power-factor the voltage over

the transmission line represented by $ag$, Figs. 1 to 6, remains constant; that is, the point $g$ is a fixed point for the power-factor $\cos\theta$. If $E_o$ is 100%, to get the receiver pressure, $E$, we describe a circular arc with $g$ as center to cut $oa$ in $o'$, Fig. 6. The length $o'a$ is then $E$, and the length $oo'$ is the percentage drop in pressure over the line. But it is easily seen from Fig. 6 that $oo' = fg$, and therefore the percentage drop in pressure over the line when $E_o$ is fixed at 100% is the *horizontal* distance from $g$ to the circular arc marked 0%, drawn with $o$ as center and radius $oa = E_o = 100\%$. For the same current drawn by the receiver at unity power-factor the length $cf'$ gives the percentage drop in pressure. If the point $g$ falls to the left of the 0% arc the horizontal distance to the circular arc represents the rise in pressure.

In Fig. 3*a*, ⅛" represents 1%; and in Fig. 3*b*, 1/16" = 1%. The length from $g$ to the 0% arc may, therefore, be read off with an ordinary rule. It should be remembered that this distance is to be measured parallel to the base line. The percentage decrease in load, due to a decrease in $E$ below 100%, will also be given by the length from $g$ to the circular arc 0%. For, lengths along $ac$ are proportional to energy current, but since the pressure on the receiver is not 100%, $ac$ will not represent the same receiver load, but the load will be changed as $E$ changes. If $gh = E$, and $gf = E_o - E$ is, say, 25%, and ac represents full-load energy current, then the receiver load will be 75% of full load. That is, the length $gf$ represents the percentage decrease of load. If the load is non-inductive, for the same energy current, $ac$ the decrease in load will be given by $cf'$.

The device may also be used to solve the problem of finding the percentage reactance pressure when the regulation is given, or to solve any right-angled triangle when two sides are given in percentage.

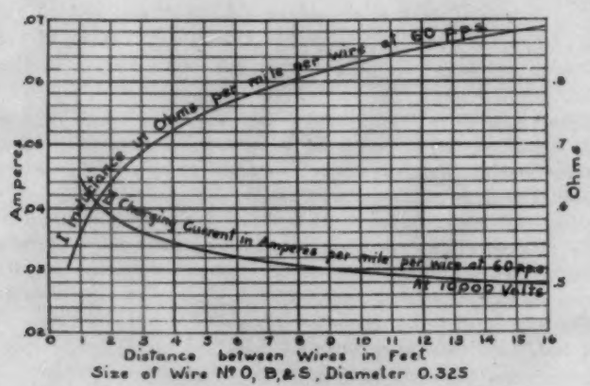



Fig. 7. Reactance and Charging Current per Mile.

Curve I. Inductance per mile, per wire at 60 p.p.s. For single-phase or two-phase, multiply by 1·15.

Curve II.—Charging currents per mile per wire for three-phase system at 60 p.p.s., 10,000 volts between wires. For single-phase or two-phase, multiply by 0·87.

For wire ¾" in diameter, spaced 12 feet, the charging current is 0·0331 amperes per mile with 10,000 volts between wires. This is 4% less than for No. 0 wire spaced 48".

When considering the regulation of a generator or transformer we have to deal, as in the transmission line, with a delivered, or secondary pressure; a resistance and reactance pressure consumed in the generator, or transformer; and the pressure generated, or delivered to the transformer. Therefore, in determining the regulation of a generator or transformer we proceed as in the case of a transmission line.

On the back of the device are given the values of the current and (current)$^2$ for the different power-factors, assuming the current at unity power-factor to be 1. Other useful information is also given.

Manufacturers of electrical apparatus now, very properly, specify the regulating properties of a transformer, or generator, by giving the resistance pressure and reactance pressures in percentage of delivered pressure, so that the calculating device is in its most convenient form. The percentage resistance pressure is, of course, equal to the percentage copper loss in a generator, transformer, or line at non-inductive full load.

We see from what has been said that in order to use the calculating device to determine the results desired it is necessary to determine the resistance and reactance pressures consumed by full-load current, the pressures being given in percentage of normal voltage at the point of fixed pressure. Methods of determining these pressures will now be given.

### Calculation of Percentage Resistance and Reactance Pressures of Transmission Lines.

Let $R$ = resistance of one wire from generator to receiver in ohms; $Lw$ = reactance of one wire from generator to receiver in ohms. (For $Lw$ take inductance per mile from the curve in Fig. 7 and multiply by the length of the line in miles.) Let also, $I$ = amperes per wire at non-inductive full load; $E$ = e. m. f. between wires in volts at point of fixed pressure. Then, for three-phase, percentage resistance pressure $= \sqrt{3}(IR/E)100$; percentage reactance pressure $= \sqrt{3}(LwI/E)100$.

For single-phase or two-phase system replace $\sqrt{3}$ in the above by 2.

*Example.*—Length of line = 15 miles, voltage between wires = 5000, and full-load current = 60 amperes. From the curve in Fig. 7 we find the inductance = 10 ohms for 30" between wires. Hence, percentage reactance pressure $= \dfrac{\sqrt{3}\times 10\times 60\times 100}{5000} = 20{\cdot}75$.

For a line 150 miles long, and 50,000 volts between wires, the percentage reactance pressure is practically the same.

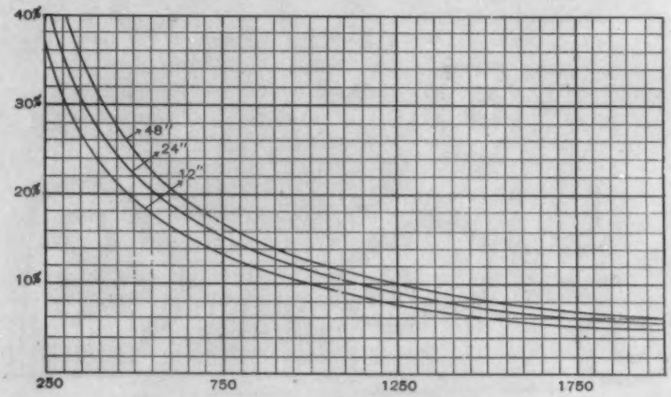



Fig. 8. Ratio of $\dfrac{\text{Volts Between Wires}}{\text{Miles of Line}}$.

*Curves give percentage reactance at 60 p.p.s.*

Conditions: Three-phase system, No. 0, B. & S. wire, 100 amperes per wire.

| | | |
|---|---|---|
| For single-phase or two-phase, multiply ordinates by | | 1·15. |
| For any other current | " " | $I/100$ |
| For any other frequency | " " | $f/60$ |
| For No. 1 wire, | " " | 1·02. |
| For No. 2 wire, | " " | 1·04. |
| For No. 3 wire, | " " | 1·06, etc |

For wire ¾" in diameter with 12 feet between wires add 4% to curve for No. 0 wire spaced 48".

We see that in the formula for the reactance pressure we always have the ratio of the voltage between wires and length of line in miles. Assuming a given number of amperes flowing in the line, say 100, we may construct a curve between the percentage reactance pressure and the ratio of volts to length of line in miles $= E/L$. This has been done in Fig. 8, from which the percentage reactance pressure for any given case may be quickly determined. Curves are given for 12", 24", and 48" between wires. The results are given for a three-phase line with 100 amperes per wire, frequency = 60 p. p. s., size of wire equals

No. 0, B. & S. These curves bring out in a striking way the effect of reactance in the line, and the difficulties of regulation in long lines. For any other current, $I$, multiply the percentage reactance pressure by $I/100$; for any other frequency multiply by $f/60$. For a single-phase, or two-phase system, multiply the percentage reactance pressure by 1·15. For No. 1 wire multiply the percentage reactance pressure by 1·02; for No. 2 wire, multiply by 1·04, etc. A great deal of labor may be saved by becoming familiar with the use of Fig. 8.

*Example.*—Voltage between wires = 50,000; distance between wires = 24"; length of line = 100 miles. Then $E/L = \frac{50,000}{100}$ and from the curve, Fig. 8, we find the percentage reactance pressure = 22·1. The reactance pressure in volts per loop will be ·221 x 50,000 = 11,050, or $\frac{11,050}{\sqrt{3}}$ (= 6390) volts per wire.

### Measurement of Percentage Resistance and Reactance Pressures of Transmission Lines.

Measure $R$ as usual and calculate the percentage resistance pressure; then short circuit receiver and determine the percentage of normal receiver pressure necessary to force full-load current over the line. Suppose, as in Fig. 5, the percentage resistance pressure = 7%, and that 21% of normal receiver pressure is necessary to force full-load current over the line when on short circuit: $ac$ is rotated until 21 and 7 coincide, and the reactance pressure = 20%, is read off.

### Determination of Percentage Resistance and Reactance Pressures of Transformers.

The resistance pressure, or copper loss, of small lighting transformers is about 1½ to 3%. For large transformers the resistance pressure may be 1% or less. The percentage reactance pressure of transformers is usually between 3 and 10%—about 3 to 5% for 2000 volt, medium-sized transformers.

If copper loss and regulation on non-inductive load are given, then the percentage reactance pressure may be determined from Fig. 3.

*Example.*—Resistance pressure equals 1½%, and regulation on non-inductive load given as 2%: Follow the circular arc marked 2% from the bottom of the figure until it passes through the horizontal line marked 1½%. The length of the vertical line, 9%, gives the reactance pressure.

In using the calculating device to find the regulation of a transformer, the pressure delivered by the transformer is the receiver pressure. $ab$ and $bc$, then, being determined in percentage of the delivered pressure, we obtain the percentage by which the primary pressure, divided by the ratio of transformation, must exceed the secondary pressure. In determining the regulation of a transformer proceed as in the case of a transmission line.

*Example.*—Resistance pressure equals 1½% and reactance pressure 9%. Regulation on non-inductive load equals 2%; regulation on 0·9 power-factor, lagging current, equals 6%.

If the primary pressure is fixed, the percentage drop in pressure through the transformer is measured by the horizontal distance, $g$ to the 0% arc, as in Fig. 6.

### Resistance and Reactance Pressure of Transformers by Measurement.

Let $R$ = resistance of primary, $r$ = resistance of secondary, $a$ = ratio of transformation, $I$ = primary current, $E$ = primary pressure. Then percentage resistance pressure $= \frac{I(R + r a^2)\ 100}{E}$

To find percentage reactance pressure: Short circuit secondary and determine percentage of normal pressure which applied to primary will send full-load current through the transformer. The percentage resistance pressure is the base, and the percentage pressure to give full-load current on short circuit is the hypotenuse of the triangle $abc$. Rotate $ac$ until a triangle is obtained having the requisite base and hypotenuse, then read off the reactance pressure in percentage.

### Percentage Resistance and Reactance Pressure of Generators.

If a generator has 2% resistance pressure, and the regulation on non-inductive load is 6%, what is the reactance pressure? The circular arc, Fig. 3, marked 6%, passes through the horizontal line marked 2% and the vertical line marked 28½%. Therefore the percentage reactance pressure is 28½%.

### Reactance Pressure of Generator Determined by Measurement.

Measure resistance as usual, and calculate the percentage resistance pressure by the formula $IR100/E$. To measure the reactance, or the synchronous reactance, as it is generally called: Short circuit generator, run at normal speed, and determine the pressure generated (this is determined from the excitation) to force full-load current through the generator. Having two sides of the triangle, rotate $ac$ until conditions are fulfilled, and read off the reactance pressure.

Another method of determining the synchronous impedance* is as follows: Run the generator as a synchronous motor at no load. Now lower the excitation of the motor, or raise the voltage applied to it, until full-load current flows in the motor. Since the load on the motor is small, the pressure developed by it will be practically in opposition to the pressure applied. The difference between the pressure applied and the pressure developed by the motor (the pressure developed by the motor may be determined from the excitation) is the pressure, $E'$, forcing full-load current through the motor. The ratio of $E'$ to the normal pressure gives the percentage impedance pressure. The synchronous impedance is then

$$\text{Synchronous impedance} = \frac{E'}{I}.$$

$$\text{Percentage impedance pressure} = \frac{E'}{E} 100.$$

In the last equation, $E$ is the normal pressure delivered by the machine at its terminals. On account of the small resistance compared to the reactance, the impedance pressure may be taken as the reactance pressure.

Usually the synchronous reactance pressure varies between 25 and 50% of the normal pressure developed by the machine; for most generators it is between 30 and 50% of normal pressure. This means that the short-circuit current at normal voltage is between two and three times full-load current.

When we are considering the regulation of a generator, the receiver pressure is the terminal pressure. The value obtained for the "percentage pressure above receiver" is the percentage by which the generated pressure, $E_0$, must exceed the terminal pressure for the given load. If $E$ is the terminal pressure, and the regulation is found to be 10% for a given load, the generated pressure must be equal to 1·1$E$. In any case, after determining $ab$ and $bc$ in percentage of the receiver pressure, $E$, we proceed as in the example given on the back of the calculating device.

If the generated pressure is 100%, the percentage drop in pressure through the generator is measured by the horizontal distance $g$ to the 0% arc, as in Fig. 6.

### Regulation of Transmission System.

If we wish to determine the regulation of a system consisting of step-down transformers, transmission line, and step-up transformers, we first find the percentage resistance and reactance pressure of each set of transformers and the line. Then add the percentage resistance pressures, and also the percentage reactance pressures, and treat as though this resistance and reactance were all in the line. If the generator is to be included add the resistance and reactance pressure of generator.

*The synchronous impedance is the apparent impedance.

### Rise in Potential Over Transmission Line Due to Charging Current.

Suppose the percentage resistance pressure on full-load current to be 7%, and the reactance pressure 20%, as in Fig. 5; let the charging current be 50% of full-load current. (If the full-load current is 60 amperes, and the voltage between wires is 60,000, then at 60 p. p. s. the charging current of a line 150 miles long will be about 31 amperes.) This current may be assumed concentrated at the center of the line, and is practically wattless. Come down $ac$ to $21/4 = 5{\cdot}25$, because we have half-load current taken off at the center of the line. Now go along a circular arc with center at $a$, the distance 5·25 from $a$, until we come to $\cos\ \theta = 0$, leading current. The rise in pressure is seen to be about 5%.

The percentage rise in voltage over a transmission line, due to charging current, may be rapidly calculated, with the help of the curves given in Fig. 7, by the formula:

$$\text{Percentage rise in voltage} = \frac{\sqrt{3} \times Lw \times \text{charging current} \times 100}{2 \times \text{voltage between wires}}$$

$$= \frac{\sqrt{3}\,(Lw \text{ per M})\,(\text{charg. current per M})\,(\text{length of line in M})^2 \times 100}{2 \times \text{voltage between wires}}$$

M = mile of line.

(This formula is approximate, but is accurate enough for all practical purposes.)

For single-phase or two-phase, replace $\sqrt{3}$ in the above by 2.

In Fig. 7 is given a curve for the charging current in amperes per mile at 60 p. p. s., with 10,000 volts between wires, for a three-phase system. For single-phase or two-phase multiply charging current by 0·87.

### Application to Synchronous Motor Calculations.

Electrical engineers will immediately see the advantage of the device in adjusting the excitation of synchronous motors so that any degree of compounding of a transmission line may be obtained. This may be explained with reference to Fig. 2. $ab$ represents the percentage resistance pressure, and $bc$ the percentage reactance pressure consumed over the line between generator and motor when the motor is carrying *full load*, the power-factor at the motor terminals being unity. (We are to remember that the power component of current, at any power-factor, is proportional to $ac$, and the wattless component proportional to $cg$.) Suppose it is desired to excite the motor so that the pressure at its terminals shall remain constant for all loads, and that at 0·65 load the motor shall draw non-inductive current. The circular arc marked 6% passes through the point 0·65 along $ac$. The generator pressure, then, is to be 6% higher than the receiver at all loads. At any other load the motor must be so excited that the pressure consumed over the line by the wattless current will reach from the line $ac$ to the 6% arc. That is, the locus of the point $g$ must be along the 6% arc. At 0·2 load, for example, we see, by going at right angles to $ac$ until we come to the 6% arc, that the power-factor must be 0·725, lagging current. The wattless component of current may be scaled off; for 0·2 load it is about equal to the load component. At full load we get the power-factor by going at right angles to $ac$ at the point $c$ until we come to the 6% arc. The power-factor is about 0·98, the wattless component being about 0·2, leading current.

The constantly recurring questions concerning the synchronous motor which come up when we operate such motors, especially on transmission lines, make it desirable to have some simpler method of making synchronous motor calculations than those commonly used. With the use of the calculating device, any problem concerning a synchronous motor may be solved without any mathematical work.

The theory of the synchronous motor is very much simplified if we look at it as the inverse of the generator. In the case of a generator, the important quantities are those measured at the terminals; that is, the terminal pressure, the current delivered, and the power-factor. We therefore take the delivered pressure applies. In the case of the synchronous motor, the important quantities are again the terminal values of the pressure, the current supplied to the motor, and the power-factor.

In the case of the generator, the diagram for determining the value of the pressure, $E_0$, to be generated for any load and any power-factor, is the same as Fig. 1.

Let us now operate this generator as a motor. $E_0$, the pressure generated, is now the back e. m. f. of the motor. Let $x_0$ be the synchronous reactance, and $r_0$ the resistance of the motor. $E$ is the voltage applied to the motor (if $E$ is not constant at the motor terminals, but at some point on the line, then the reactance and resistance of the line on the motor side of the point where $E$ is maintained constant must be added to $x_0$ and $r_0$). If we leave $E_0$ drawn to the right as before we must reverse $E$ and also the current, so that the motor consumes power. In Fig. 9 the terminal pressure and current have been reversed. The terminal pressure is $ao = E$. $I$ is the current delivered to the motor, and $\theta$ the angle between $E$ and $I$. The pressure consumed by the resistance due to the power component of current is $I \cos\ \theta\ r_0 = ab$, and the pressure consumed by the synchronous reactance is $I \cos\ \theta\ x_0 = bc$. $ac$ is, therefore, the pressure consumed by the impedance due to the power component of current. The pressure consumed by the wattless component will be at right angles to $ac$, to left of $ac$ for lagging and to right for leading currents. (In the generator, lagging current consumes pressure to right of $ac$ and leading current to left.) In Fig. 9, $z_0 = \sqrt{r_0^2 + x_0^2}$ is the synchronous impedance of the motor; and, therefore, $z_0 I \sin\ \theta = cg$, or $cg'$, is the pressure consumed by the impedance of the motor by the wattless current. If the current for the load corresponding to $ac$ is to be in phase with the terminal pressure, the motor must be excited so that the back electromotive force, $E_0$, is equal to $oc$. If the current taken by the motor for the same load is to lag by the angle $\theta$, $og'$ is the value of $E_0$; and if the current is to lead by the same angle, $og$ is the value of $E_0$. $ac$ is proportional to the power component of the current supplied to the motor—that is, proportional to the power input; and $cg$, or $cg'$, is proportional to the wattless component of the current. It will be immediately seen that the excitation to produce any given power-factor at any load may be at once determined.

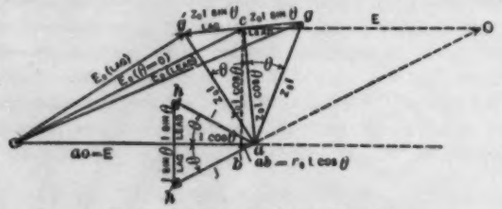



Fig. 9. Synchronous Motor Diagram.

The angle which $ac$ makes with the vertical is determined, as in the case of the generator, by laying off $ab$ and $bc$. Since $ab$, however, is laid off to the left of $a$, $ac$ will be to the left of the vertical line instead of to the right, as in the case of the generator. The angle may be found on the right-hand side of the vertical, as in the case of the generator, and $ac$ then rotated so as to make an equal angle to the left of vertical, or the angle may be laid off with a protractor. When solving synchronous motor problems, the words "lagging" and "leading" on the celluloid must be read interchanged. The angle between $ac$ and $ab$ will generally be between 85° and 90°, if $E$ is constant at the motor terminals. If a transmission line is added between $E$ and the motor, the angle between $ac$ and $ab$ will probably be reduced.

As there are questions arising sometimes, such as the over-

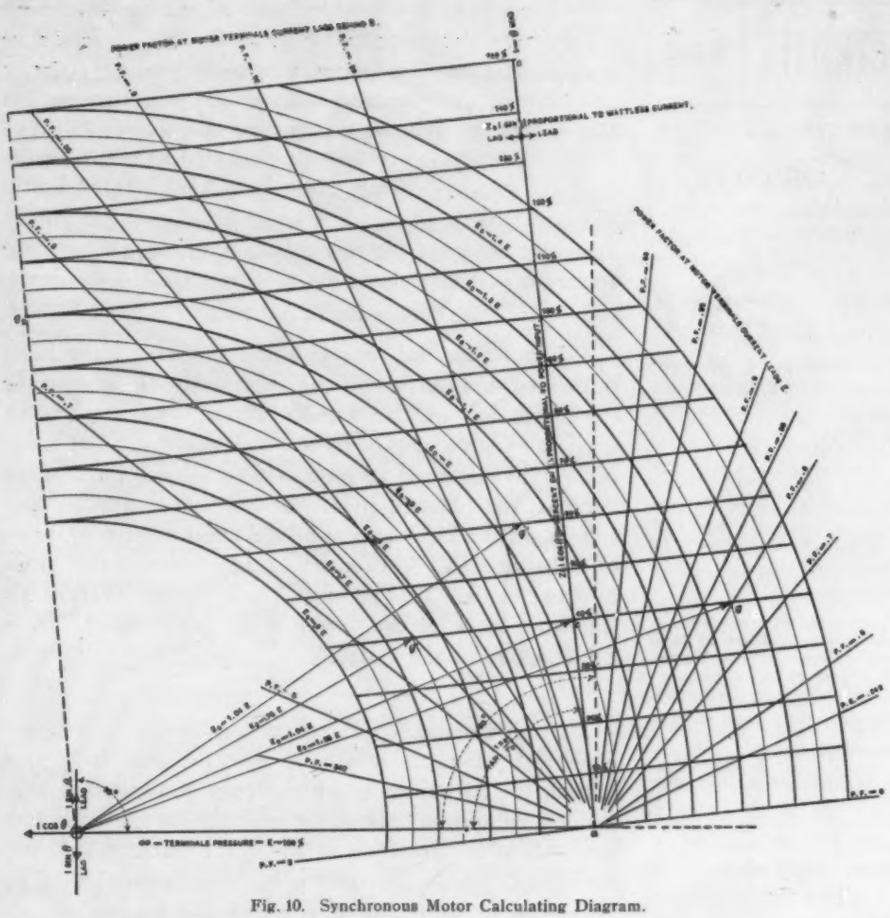


Fig. 10. Synchronous Motor Calculating Diagram.

the current. If a given motor consumes 40% pressure on full-load current, then the point 40% would represent full-load input into the motor. In the calculating device, points along *ac* are marked 1, 2, 3, etc., representing 1%, 2%, etc., of receiver pressure.

The following examples are given to show the use of the calculating device in making synchronous motor calculations. Assume that 40% pressure is consumed by the impedance by full-load current. In all the examples reference is made to Fig. 10; the results may be checked with the calculating device.

(1) Find the excitation which will give a power-factor of unity at full load. Go along *ac* to the point marked 40%, Fig. 10, and we see that the motor must be over-excited 5%. To give a power-factor of 0·8 leading current at full load, go to the point *g*: excitation equals 1·34*E*. To give 0·8 power-factor lagging current for the same load, go to the point *g'*: excitation equals 0·77*E*. (Constant input means practically constant output, since the variable loss due to $I^2r_0$ will change very little.)

(2) What excitation will make the wattless lagging current equal to one-half the load current when the motor is carrying half load? Go along the line at right angles to *ac* at the point 20%, a distance equal to one-half the distance from *a* to 20%: excitation equals 0·9*E*.

(3) Suppose the excitation to be 0·9*E* at one-quarter load, what will be the power factor and wattless current? The intersection of $E_0 = 0{\cdot}9E$ with the line at right angles to *ac* at the point 10% gives a power-factor of 0·7+, and a wattless current equal to the load-current.

(4) For any particular position of $E_0$, the electrical angle through which the motor must swing from no load to the new load corresponding to the given position of $E_0$ is equal to the load capacity, etc., which are beyond the range of the calculating device, Fig. 10 is given. The angle betwen *ac* and *ab* is 84½°. Points along *ac* bave been marked 10%, 20%, etc., corresponding to the percentage pressure consumed by the power component of angle between $E_0$ and $E$. (This assumes, that instead of the true self-induction and the magnetising or demagnetising effect of the armature, we may use the synchronous reactance.) The mechanical angle through which the motor must swing will be equal to the electrical angle divided by the number of poles.

(5) What is the maximum input when $E_0 = E$? Follow the circular arc $E_0 = E$ until we get maximum protection on *ac*. The projection on *ac* gives the load. The length along *ac* is seen to be 110 %. Therefore, the input (110/40) equals 2·75 times full load. The power-factor, as shown, would be about 0.75. The current in the motor is $ag_3$, and may be scaled off.

If $E_0$ is less than $E$, we see that the overload capacity, or the maximum load which the motor will carry, will be reduced. The oyerload capacity will vary inversely as the percentage pressure consumed by impedance. For example if another motor consumed 80% pressure on full-load current, then the point 80% would represent full load, and the overload capacity would be 110/80, or reduced one-half.

(6) To determine the *V*-curves between the excitation and current for the same input, we may proceed as in the following example: For full load, if $E_0 = 1{\cdot}05E$, the current is a minimum, and equal to the length from *a* to the point along *ac* marked 40%. If $E_0 = 0{\cdot}77E$ the armature current is $ag'$. If $E = 1{\cdot}34E$ the armature current is *ag*. For any other load, move along the line at right angles to *ac* at the point corresponding to the load.

(7) Suppose this is the motor operating at the end of a transmission line, as explained before. At 65% load the motor was to be so excited as to draw non-inductive current, and at 20% load the power-factor at the motor terminals was to be 0·725. Going to Fig. 10, we see that to produce these power-factors the excitation at 65% load must be 1% higher, and at 20% load it must be 10% lower than the terminal pressure. If we assume the losses in the motor and its attached generator to be 10%, we see from Fig. 2 that the motor should draw, when delivering no load, 25% wattless current. In order that the wattless current taken by the motor at no load shall be 25% of the full-load current we see from Fig. 10 that the excitation at no load must be practically 10% lower than the terminal pressure. By setting the shunt excitation of the synchronous motor so that at no load the motor is underexcited 10%, and then adjusting the series excitation for non-inductive current at 65% load—that is, 1% higher than the terminal voltage—changes in load on the motor will have little effect on the line pressure.

The reader will have no difficulty in solving other alternating current problems. For example, the problems solved in Steinmetz's "Elements of Electrical Engineering," p. 44-102 and 121-162, may be solved very quickly with the device.

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Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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There is an indefinable fascination connected with a miniature reproduction of large things. A model of a steamship or of a locomotive is interesting alike to the layman and the technical man. For this reason the model four-kilowatt plant on the shores of Lake Tahoe is likely to prove as productive of comment as would a 40,000-kilowatt plant elsewhere. Incidentally the regulator with which it is equipped and which was specially designed for this plant, may prove applicable to larger installations.

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From time to time in these columns have been published descriptions of the great hydroelectric power developments of the Pacific Coast. Accompanying each has been a map of its transmission lines, but these individual maps are an unsatisfactory basis for relative comparison. Hence it is believed that engineers and others will find the map of all the transmission systems of California and Nevada which accompanies this issue of great value. It is to be followed by others showing the same facts for the rest of the great territory "from the Rockies to the Coast."

---

From Portland, Oregon, comes notice of another electrical casualty which is directly due to police stupidity. Although every evidence showed that suspended animation was being restored by the energetic methods of resuscitation to which the victim was being subjected, yet an officious policeman ordered that he be placed in an ambulance which had meanwhile arrived. The patient died on his way to the hospital, whereas there was strong probability of his recovery if the good work which had been started could have proceeded without delay. Although proper means have now been taken to impress upon all members of the force the necessity for immediate and continuous action for the relief of electric shock, yet it seems to be a case of "locking the stable door after the horse is gone." Yet, if this instance can be sufficiently emphasized there is hope that other deaths may be hereafter averted.

---

The calculation of alternating current problems has become involved in such a mantle of mystery and a cloud of complexity that many practical men are deterred from attempting their solution. While the calculus is undoubtedly a powerful tool for attacking the question and while the physical significance can be made clearer to students by the aid of the higher mathematics, yet these same problems can be approximately solved by simple rules. We all crept before we walked and most of us are yet walking before we attempt to fly. We marvel at the mathematical flights of Steinmetz as we do at the aerial feats of Paulhan and the Wright brothers. Yet for practical purposes we are content wtih less spectacular methods. Among these is a time saver devised by F. G. Baum for

determining alternating current regulation and described in this issue. While it is not in the "creeping class," yet it is adapted for practical use.

---

The appalling life cost of coal is seldom considered when it is burned under boilers. Every industry has its hazards, but the life of the coal miner is particularly perilous. This week brings news of four more disastrous explosions, in Colorado, in Kentucky, in Mexico and another in Illinois, whose death toll is to be added to that of the Cherry mine last November. It is difficult to place responsibility for these accidents but statistics show that they are usually due to the carelessness bred of familiarity. It was hoped that the substitution of the incandescent electric lamp for the flame of the candle or inclosed oil lamp would eliminate much of the danger, but even electricity is not fool-proof. Notwithstanding our tremendous oil production and the increasing development of hydro-electric power, coal is likely to be our chief power source for years to come. Yet its present use seems little short of aiding and abetting wholesale murder.

---

**Ballinger Investigation**

The "Journal" has been struck by a line credited to the Chicago Tribune that "the country will stand by Pinchot right or wrong." The opinion of the editor of the Chicago Tribune is no better than that of any other well-informed man. We are prepared to say that while at first many were inclined to sympathize with the dismissed Forester the conclusion is being forced on the world that Mr. Pinchot deliberately planned to withdraw from the Forestry bureau, so as to be able to engage in the Ballinger investigation without being trammeled by official ethics. He is not to be blamed but praised for this.

It is also quite apparent that he determined not to resign and carefully planned a course of action that could only result in his dismissal by the President. He is to be censured for this.

This course was taken so as to bring upon the administration just the sort of unjust criticism that is now being levelled at Mr. Taft.

Mr. Pinchot would have been a bigger man, and would stand before the American people today in a more honorable attitude had he resigned and frankly stated his purpose to have been a desire to participate in the investigation of Mr. Ballinger. He felt that he could better serve the country in this connection than by continuing in public office. Then why not frankly say so and acquit the President.

As to Mr. Ballinger, we have already expressed our views. He is better off in private life. The country and its development have been retarded by Mr. Ballinger, and the whole question of conservation and private development on public lands has become so acute, so sore and tender as to preclude any rational settlement for years to come. The interests that sought Mr. Ballinger's appointment and imposed him upon the President were over greedy. The concerns that stand for fair treatment, honest development and ask only that which is fair to the government and the people, may well cry "A plague on both your houses."

---

**Plant Depreciation**

A full appreciation of the fatal meaning of depreciation is not granted to most of us until we try to sell a second-hand article. We are surprised to find that it became second-hand as soon as we paid for it, and from that time its value has continued to decrease. A thousand agencies seem to be at work hammering down its price. If it fortuitously escapes all these casualties which our insurance friends classify as "fire, earthquakes, storms, or other acts of God," it is liable to be superseded by some change in style or some improvement in method that renders it obsolete. Meanwhile it is constantly subject to the wear and tear of ordinary use, such destruction irresistibly driving it to its inevitable goal, the junk heap. Save for an occasional exception such as wine, a rare old violin or a fine painting, all things lose value with age.

Power plant machinery is not among the immune. A municipal electric lighting plant recently failed because its management had not allowed for depreciation of apparatus when they made the rates. After several years of successful operation, they suddenly became painfully aware that their plant was worn out. Plant replacement had not entered into their original calculations and in consequence it was shut down. This lack of financial foresight is not confined to municipal operations, for it is occasionally evident in the statements of private corporations whose directors are more interested in immediate dividends than in future deterioration.

Depreciation is a vital factor in the cost of doing things. Machine serviceability is strictly limited by its useful life. A certain part of its yearly earnings should, therefore, be annually set aside to provide for this replacement. If men invest in a proposition whose success is largely dependent upon the personality of its manager they insure his life to protect their investment. The useful life of a machine is even shorter than that of a man. Its rate of insurance should be correspondingly high.

The depreciation to which all classes of power apparatus is subject, has been accurately figured by competent authorities. It is a simple problem to apply these figures to the equipment of any power plant, and determine what provision should be made for deterioration. In many European countries neglect to take the ordinary precaution of reckoning depreciation before calculating profits is illegal. In any country it is morally wrong. It requires more honesty and more courage to write off from the books an obsolete machine than a bad debt. Yet one is as valueless as the other .

## PERSONALS.

F. B. Crocker passed through San Francisco this week

Thomas Mirk, of Hunt, Mirk & Co., engineers, is in Los Angeles.

F. C. Greene, of the transformer department of the General Electric Company, is visiting the Pacific Coast.

John M. Gardiner, who is prominent in electric railway circles on the Coast, is in San Francisco from Los Angeles.

George R. Murphy, of the firm of Pierson, Roeding & Co., of San Francisco, has returned from a business trip to Seattle.

M. A. Bryte, Pacific Coast representative of the Sterling Lamp Company, has returned to San Francisco from a trip East.

F. D. Fagan, illuminating engineer, with the General Electric Company's San Francisco office, has returned from a trip to Stockton.

F. V. T. Lee, who has been assistant general manager of the Pacific Gas & Electric Company for some years past, has just resigned.

H. Vensano, who was for some time assistant to J. H. Wise, has been appointed civil engineer for the Pacific Gas & Electric Company.

I. W. McConnell has resigned as supervising engineer, United States Reclamation Service to become chief irrigation engineer for J. G. White & Co.

William G. Kerckhoff, who is heavily interested in electric power companies in Los Angeles was a visitor in San Francisco during the past week.

Fred T. Mumma has been promoted from foreman of construction to superintendent of the Big Bend power plant of the Great Western Power Company.

W. A. Purcell, manager of the California Electrical Construction Company of San Jose, was in San Francisco during the past week, placing orders for supplies.

P. D. Frazer, construction foreman for the General Electric Company, has completed some high-tension transformer work near Tacoma and is now in San Francisco.

J. H. Wise has resigned as civil and hydraulic engineer for the Pacific Gas & Electric Company, to enter the firm of F. G. Baum & Co., engineers and constructors, San Francisco.

J. P. Jollyman, until recently superintendent of the Big Bend power plant of the Great Western Power Company, has been made electrical engineer for the company with headquarters in the Shreve Building, San Francisco.

Chas. E. Sloane, mining and irrigation engineer, E. B. Spaulding, electrical engineer, and F. T. Robson, civil engineer, have opened joint offices in the Union Trust Building, San Francisco, as consulting and supervising engineers.

K. G. Dunn, of Hunt, Mirk & Co., representing the Westinghouse Machine Company, left February 1st for El Paso, Texas, to make an economy test on the complete power plant, which his firm has just installed for the Southwestern Portland Cement Company.

G. R. Folds, general salesmanager of H. W. Johns-Manville Co., New York, has taken temporary charge of the San Francisco branch of the company as acting manager. C. W. Scott, the former manager, has been transferred to the Indianapolis office of the company.

Albert Spies has retired from the editorship of "The Electrical Record" to become the managing director of "Foundry News," a new illustrated monthly publication devoted to the foundry arts, with offices in the Hudson Terminal, 50 Church Street, New York. "Foundry News" will make its first appearance in April.

## CALIFORNIA METAL TRADES BANQUET.

About 150 members of the California Metal Trades Association celebrated the third annual installation of officers at a banquet given in the Palace Hotel on Saturday evening, January 29, 1910. J. M. Robinson, of the Keystone Boiler Works, was again installed as the association's president, S. J. Eva and Constant Meese, vice-presidents, and H. F. Davis, secretary. The general executive committee are: R. H. Postlethwaite, Risdon Iron and Locomotive Works, Potrero; John A. McGregor, Union Iron Works Company, San Francisco; John T. Scott, Moore & Scott Iron Works, San Francisco; Otto Schrader, Schrader Iron Works, Inc., San Francisco; George E. Randolph, United Iron Works, Oakland; William F. Murray, Murray Bros. Machine Works, San Francisco; George J. Henry, Jr., Pelton Water Wheel Company, San Francisco; Edward J. Fowler, Pacific Foundry Company, San Francisco.

Three members for each of the craft committees were also installed, those for the electrical manufacturers' branch being: A. E. Drendell (chairman), Drendell Electrical & Manufacturing Company, Inc., San Francisco; H. T. Adams, Farnsworth Electrical Works, San Francisco; S. H. Weidenthal, Weidenthal-Gosliner Electric Works, San Francisco.

Geo. J. Henry, Jr., of the Pelton Water Wheel Company, acted as toastmaster, introducing each of the speakers and the various entertainment features. The speakers included Harris Weinstock, P. H. McCarthy and Jos. J. Tynan, the subjects discussed being industrial peace, home industry and the ship subsidy.

## TRADE NOTES.

C. A. Maydell Co. have moved their offices from the Hansford Block to 409-11 Sheldon Building, San Francisco.

Stone & Webster plans in the Northwest for 1910 include a hydro-electric plant on White Salmon river, and thirty miles of interurban line between Bellingham and Mt. Vernon, Washington.

The Seattle-Tacoma Power Company are preparing to build a new power house at Snoqualime Falls. They are installing a 10,000 h. p. wheel, 7000 k. w. generator 2000 volt, three 2500 k. w. transformers. Stone & Webster are the contractors.

F. A. Hall, who for the past twelve years has been manager of the chain block and hoist department of the Yale & Towne Mfg. Co., 9-13 Murray Street, New York, and Stanford, Conn., has resigned to become vice-president and treasurer of the Cameron Engineering Company, of Brooklyn, N. Y. Mr. Hall's successor will be Mr. R. T. Hodgkins, who for several years has been his chief assistant, and who is thoroughly qualified by experience and ability successfully to perform the duties of the position. In his new connection Mr. Hall expects to make a specialty of trolleys and appliances or overhead handling of materials.

## NEW CATALOGUES.

Holophane Illumination for January, 1910, contains interesting information about scientific lighting from the Holophane Company.

The January issue of Hot Points from the Pacific Electric Heating Company of Ontario, Cal., contains interesting data regarding the Standard Hot Point Iron for 1910.

MacGovern, Archer & Co., 114 Liberty Street, New York City, have issued their February list of second hand electrical and steam machinery, power house equipment, cars, etc., which they have for sale.

Catalogue No. 24 from the Chicago Fuse, Wire & Mfg. Co. is devoted to Fuse Protecting Material, including enclosed fuses, blocks and fittings, open link fuses, and fuse wire for all electrical purposes.

# NEWS OF THE STATIONARY ENGINEERS

**PREAMBLE.—This Association shall at no time be used for the furtherance of strikes, or for the purpose of interfering in any way between its members and their employers in regard to wages; recognizing the identity of interests between employer and employe, and not countenancing any project or enterprise that will interfere with perfect harmony between them.**

**Neither shall it be used for political or religious purposes. Its meetings shall be devoted to the business of the Association, and at all times preference shall be given to the education of engineers, and to securing the enactment of engineers' license laws in order to prevent the destruction of life and property in the generation and transmission of steam as a motive power.**

**California.**

**No. 1. San Francisco, Thursday, 172 Golden Gate Ave. Pres., P. L. Ennor. Sec., Herman Noethig, 816 York St.**

**No. 2. Los Angeles. Friday, Eagles' Hall, 116½ E. Third St. Pres., J. F. Connell. Cor. Sec., W. T. W., Curl, 4103 Dalton Ave.**

**No. 3. San Francisco. Wednesday, Merchants' Exchange Bldg. Sec. David Thomas, 439 Merchants' Exchange Bldg.**

**No. 5. Santa Barbara. Geo. W. Stevens, 2417 Fletcher Ave., R. R. No. 2.**

**No. 6. San Jose, Wednesday. Pres., W. A. Wilson, Sec., Lea Davis, 350 N. 9th St.**

**No. 7. Fresno. Pres., A. G. Rose. Sec., E. F. Fitzgerald, Box 651.**

**No. 8. Stockton. Thursday, Masonic Hall. Sec., S. Bunch, 626 E. Channel St. Pres., H. Eberhard.**

**Oregon.**

**No. 1. Portland. Wednesday, J. D. Asher, Portland Hotel. Pres., B. W. Slocum.**

**No. 2. Salem. A. L. Brown, Box 166.**

**Washington.**

**No. 2. Tacoma. Friday, 913½ Tacoma Ave. Pres., Geo. E. Bowman. Sec., Thos. L. Keeley, 3727 Ferdinand St., N., Whitworth Sta.**

**No. 4. Spokane. Tuesday. Pres., Frank Teed. Sec., J. Thos. Greeley, 0601½ Cincinnati St.**

**No. 6. Seattle. Saturday, 1420 2d Ave. Pres., H. R. Leigh. Sec., J. C. Miller, 1600 Yesler Way.**

**Practical letters from engineers and news items of general interest are always welcome. Write your items regardless of style. Communications should be addressed to the Steam Engineering Editor.**

## CALIFORNIA NO. 3.

California No. 3 has been holding some very interesting meetings recently and several important topics have been discussed. The State License Bill which was brought up at the last State Convention in San Francisco was read, and adopted unanimously on January 19th, after some eloquent remarks on the advantages of a license law by a distinguished visiting Brother, Phil Ennor, President of California No. 1. Bro. Ennor occupied the president's chair and conducted the initiation ceremony when Bro. Thos. Kennedy was admitted.

The many complaints made by the merchants of San Francisco concerning the smoke nuisance, led to a discussion of the best methods of reducing smoke to a minimum, and some very valuable ideas were advanced by a number of the members as to the proper method of firing. It was proposed that a committee be formed to make a special study of the causes of smoke and how to combat them so as to advise all engineers who may be desirous of information. This matter is getting quite serious, as the dense clouds of smoke which daily befoul our fair city will testify, aside from motives of economy. The subject will be thoroughly discussed before definite action is taken. Bro. R. F. Chevalier was present and gave his views on the subject. The committee on the Engineers' ball reported that arrangements were well under way. Bro. B. E. George of California No. 1 occupied the chair. All indications promise a very successful and enjoyable affair.

The following candidates were admitted to California No. 3 during the month of January: D. J. Rogers, W. B. Leigh and Thos. Kennedy, a number of other applications being on hand.

# PRACTICAL MECHANICS.

PAPER NO. 6.

Before leaving the case of transmission between parallel axes we will cite some examples to illustrate the points brought out in the last paper. These have been taken from Robinson's "Principles of Mechanism."

Example I: An excellent needle bar motion for a shuttle sewing machine is obtained by link-work; and it is, without question, in one case, at least, the lightest running shuttle machine yet built, the whole machine being link-work mechanism.

The needle bar motion referred to is shown in Fig. 4, and is used in several different sewing machines. At *A* is a rocking shaft with a crank arm *AD* attached, the latter reciprocating between the angular positions *AE* and *AF*; the connecting link *DB* raising and lowering the needle bar *BJ*.

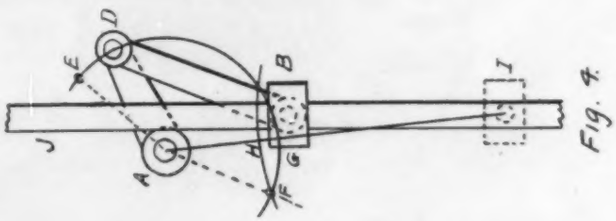



Fig. 4.

As *D* passes the line *AI* of crank and link straightened, the bar reaches its lowest position. As *D* moves on to its limit of motion at *F* the bar is raised an amount *GH*, forming the loop for the shuttle. Now it is not necessary for the needle bar to return to *G*, but on tarrying a moment raised to *H* for the shuttle point to fairly enter the loop, it may reasonably enough continue on its upward journey. By a cam it would be given this action, but by the link-work of Fig. 4 it *must* return to the lowest point again before making its ascent.

Now, if this drop by the amount *HG*, after the shuttle enters its loop, is fatal to the machine, the proposed link movement must be abandoned; otherwise it may be accepted, giving a much lighter-running and more durable combination than if the cam and pin be adopted.

Example II: Another interesting case of this is found in the Corliss valve gear, where the rocker plate swings to carry the pin *D*, Fig. 5, back and forth from *H* to *F*. The valve and stem

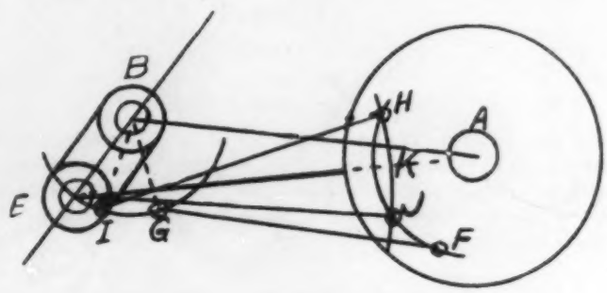
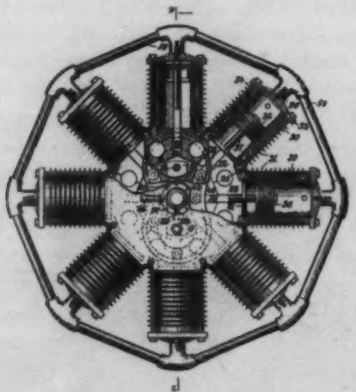



Fig. 5

*B* are moved by the lever *BE* as it swings from *BE* to *BG*. As *D* moves from *J* to *F* and return the valve is opened and closed, while from *J* to *H* and back it remains closed, but is compelled to be moving slightly, due to the arc *JDH*. If this movement represented by *DK* were out of the question, the link-work combination of Fig. 5 would have to be rejected; otherwise it may be accepted, as in fact it has been by hundreds of designers following in the footsteps of George H. Corliss.

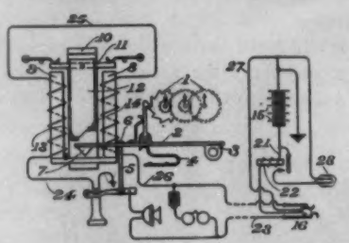
# PATENTS

**947,226. Gas Engine.** George Dorffel, Fruitvale, Cal., assignor of one-half to William C. Clark, Fruitvale, Cal. In an internal combustion engine, the combination with a plurality of cylinders, their pistons and piston rods, of a shaft, a guide rigidly secured to the shaft, means at the end of



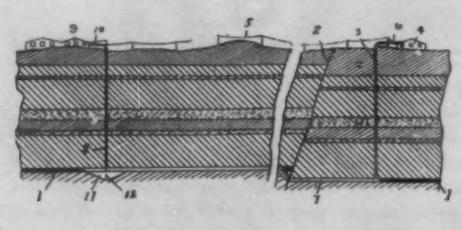
each piston rod for co-operating with said guide to rotate said shaft, and means for guiding each of said piston rods, the said means comprising a disk forming the inner head of the cylinder, and having an opening for the passage of the piston rod, and ears projecting from said disk and spaced from each other for the passage of the end of the piston rod.

**947,335. Connection-Registering Device for Telephones.** David S. Hulfish, Chicago, Ill., assignor to McMeen & Miller, Chicago, Ill. In a connection registering device for telephones, the combination of a counting train, a pawl adapted to operate said counting train when moving from one of its



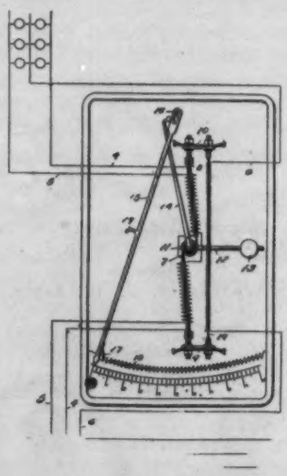
extreme positions to the other, an electromagnet adapted to hold said pawl in an intermediate position, and means associated with the telephone hook lever for restoring said pawl to one of its extreme positions when the hook lever is down, substantially as described.

**947,608. Method of Utilizing Buried Coal.** Anson G. Betts, Troy, N. Y. The process of utilizing unmined coal which consists in mining out part, and gasifying remaining coal by con-



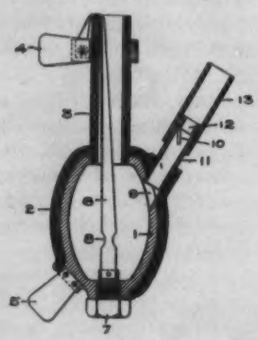
ducting air or equivalent gas thereto, which gasifies the coal and collecting the combustible gases resulting therefrom.

**947,267. Electrical Measuring Instrument.** Maurice J. Wohl, New York, and Harry Hertzberg, Brooklyn, N. N. Y. In an electrical instrument for three-wire circuit, the combination of an indicator pivotly mounted to permit a swinging movement and a longitudinal movement thereof, a serrated member over which said indicator travels, and serrations of said member being formed to permit said indicator to travel thereover in one direction but to hold the same against a



return movement, an operating member operatively engaging said indicator for movement in one direction only, means for moving said operating member in this direction, a thermally expansible wire operatively connected to said operating member, means for heating said wire by the current flowing in the outside lines of said three-wire circuit, a co-operating thermally expansible wire, and means for heating said last named wire by the current flowing in the neutral line of said circuit.

**947,235. Ventilated Fuse.** Edward M. Hewlett, Schenectady, N. Y., assignor to General Electric Company. In an



expulsion fuse, means for ventilating said fuse under normal conditions, and means for confining the blast of exploding gases to the region occupied by the fuse..

**947,448. Process of Reducing Iron Ores.** Charles B. Morgan, Oakland, Cal. The process of reducing iron ore into metallic iron, the same consisting in reducing the ore charged with its flux into a liquid condition, then withdrawing the liquefied ore charge and discharging the same onto a bed of asphaltum or liquefied carbonaceous substance which intermingles with the melted charge and separates the metallic iron from its attendant gangue or slag.

# INDUSTRIAL

## THE ELECTRICALLY DRIVEN PUMPS OF LOCKPORT, N. Y.

The city of Lockport, N. Y., derives its water supply from the Niagara River near North Tonawanda, thirteen miles away. From the electrically driven pumping station at this point, the water is forced through 69,000 feet of 30-inch main to a stand pipe 25 feet in diameter and 120 feet high, at Lockport.

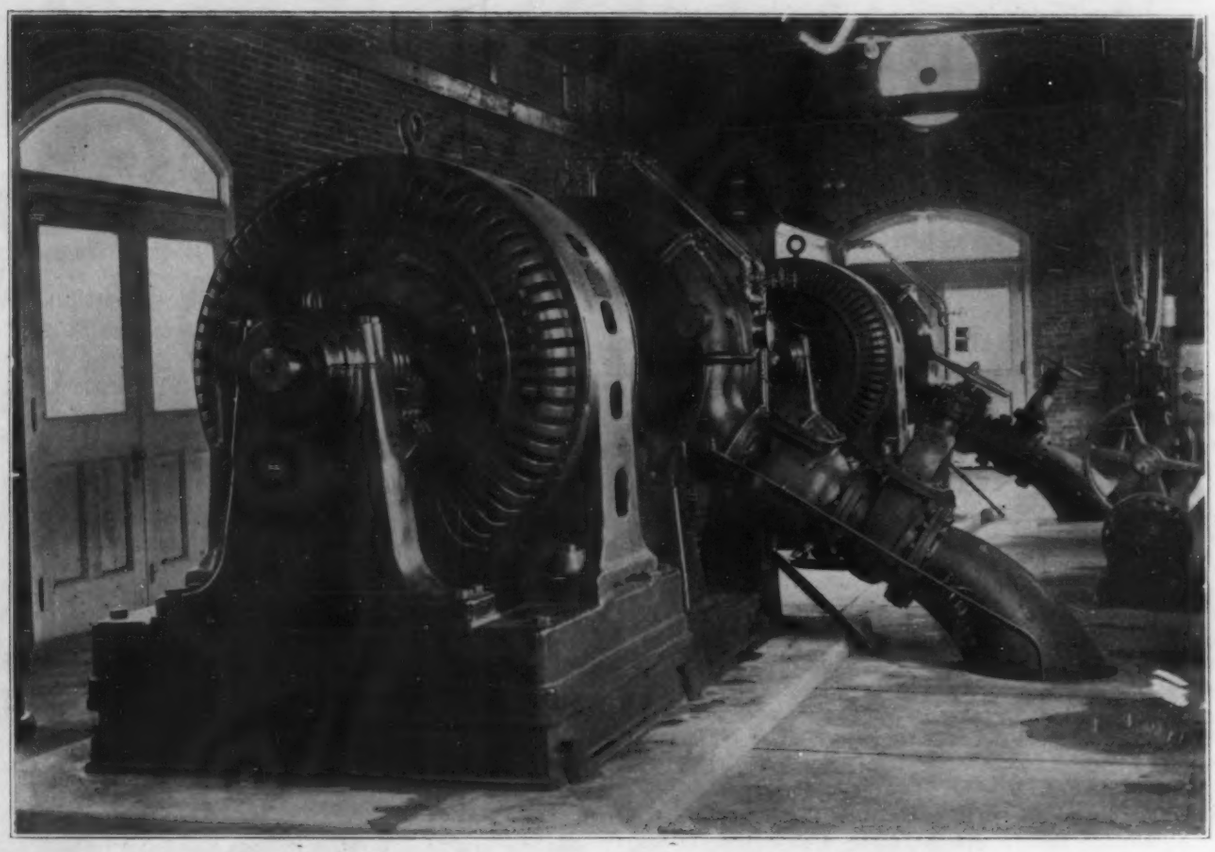
The pumping plant contains three independent units with a combined capacity of delivering 15,000,000 gallons in 24 hours against a pressure of 125 pounds. Each unit comprises a Westinghouse induction motor, designed for 500 h. p. at 750 r. p. m., with three-phase current at 400 volts, direct connected to a single suction, enclosed impeller centrifugal pump made by the Holly Manufacturing Company, Buffalo.

Power generated at Niagara Falls is transmitted to North Tonawanda at 22,000 volts and is stepped down to 440 volts at the pumping station by three 500 kilowatt, oil insulated, water cooled transformers.

The three motor driven pumping units were recently given a very complete test, which developed some interesting economics of electric operation. Each unit was run continuously for 15 hours, during which time readings of the electrical input were taken every five minutes; readings of the Venturi water meter every ten minutes; pressure gauge every five minutes, and revolutions of pump every fifteen minutes. The results are given in the accompanying table, which shows that all three of the pumps exceeded the duty requirement of 27,000,000 foot-pounds by approximately 4,000,000 foot pounds. It will be further noted that the temperature rises are well within the specifications, and that the pump capacities and horsepowers are well exceeded.

**Result of Tests of Lockport's Motor Driven Pumping Units.**

| | Pump 1. | Pump 2. | Pump 3. |
|---|---|---|---|
| Maximum rev. per min.... | 746 | 752 | 744 |
| Minimum " " " .... | 738 | 738 | 739 |
| Average " " " .... | 743 | 744 | 743 |
| Maximum gauge pres. lbs. | 142.5 | 144.5 | 143.5 |
| Minimum " " " . | 119.5 | 139.5 | 134.5 |
| Average " " " . | 136.9 | 142.6 | 138.9 |
| Average head, feet..... | 315.8 | 329.1 | 320.6 |
| Gallons pumped per hour.. | 238,000 | 236,300 | 236,700 |
| Gallons pumped in 24 hrs. at this rate..... | 5,712,000 | 5,672,000 | 5,712,000 |
| Kilowatt input per hour.. | 342.4 | 346.1 | 341.5 |
| Gallons per kilowatt hour | 1,454 | 1,464 | 1,443 |
| Hydraulic horsepower.... | 318 | 327 | 319.5 |
| Electric horsepower..... | 456.6 | 456 | 455 |
| Efficiency per cent..... | 69.6 | 71 | 70 |
| Duty, foot-pound per 1000 k. w.....30,800,000 | | 31,600,000 | 31,000,000 |
| Degrees temperature rise in 15 hours..... | 41 | 38 | 43 |



Electrically Driven Pump of Lockport, N. Y.

In the case of the Lockport pumping station, electrical energy is purchased at $16.00 per horsepower year. The cost of power for this station is thus just about equal to that of steam operation under conditions assuming cross-compound pumping engines giving a duty of 130,000,000 foot pounds per 1000 pounds of steam; coal at $3.00 per ton delivered into the boiler room; 8½ lbs. evaporation under working conditions, and including labor for making steam and handling ashes, as well as increased fixed charges against the additional plant for operating with steam. This electrically driven pumping plant is thus developing duty equal to 130,000,000 foot-pounds per 1000 pounds of steam.

In connection with this plant which is pumping its output about 13 miles to Lockport, it may be of interest to note

that last summer when a large fire broke out there, eleven powerful fire streams through varying lengths of hose were maintained from the stand-pipe and pumps as long as needed for service. The entire water supply of which this station forms a part, as well as the station itself, were designed by Mr. Charles A. Hague, consulting engineer, New York City.

## TIME INDICATED BY ELECTRIC FLASHES.

Long since has the "curfew tolled the knell of parting day." The school bell hastens the lagging steps of boy and girl; beautiful chimes remind us of the hour of service. the clanging gong calls the fireman to his post while the town clock, the pride of the village, solemnly announces the hour. Thus, in a hundred ways, are we reminded of time, or the passage of time, by tone long since familiar.

Town and tower clocks have been illuminated before now but it has remained for the highest office building in the world to flash forth the hours and the quarters.

There are clocks and clocks but giant clocks are not numerous. In the Metropolitan Tower, New York City, 346 feet above the sidewalk, is the largest as well as the most unique four-dial clock in the world, the dials of which are more than 26 feet in diameter. The huge hands weighing 1000 and 700 lbs. respectively, point to figures four feet high and pass over minute marks 10½ inches in diameter. At each quarter-hour the famed Cambridge chimes swell and roll over 1/16 of the population of the United States. The hours are struck on a 3½ ton bell with a 209 lb. blow, which is heard for many miles. Electricity drives this giant mechanism in an action entirely automatic.

As New York is not only a city of light but a city which demands light, night time finds the four dials of this clock brilliantly illuminated by more than 800 25-watt General Electric tungsten lamps, an equivalent of sixteen thousand candles. At any desired time hundreds of G. E. tungsten lamps appear behind the numbers on the dial, while the entire length of the hands, 17 and 13 feet respectively, is brilliantly lighted with a splendid effect which, it is stated, "has not been produced by any other clock in the world."

During the evening hours, the tower stands forth, a veritable pillar of light against the sky; but by far the most novel and interesting feature of either the clock or its lighting is the unique method by which the hours and quarter hours are "flashed" over the city and its environs. Seven hundred feet above the sidewalk is the terminal feature, a large octagonal electric lantern from which powerful flash lights mark the hours of the night. One, two, three or four red flashes mark the quarter hours, while the hours are designated by the appropriate number of white flashes. The lighting of this lantern is effected by 56 100-watt and 88 250-watt General Electric tungsten lamps, a total of 22,080 candle power.

The combined effect at midnight on eye and ear is not easily forgotten. Simultaneously with the swelling roll of the Cambridge chimes and the dozen deeper, hoarser tones of the great bell, the huge lantern flashes and scintillates like a giant jewel, now red, now white.

## VULCAN EXHIBIT AT CHICAGO ELECTRICAL SHOW.

The Vulcan Electric Heating Company has one of the most interesting exhibits at the show on account of the demonstrations. These are all of practical value as the Vulcan devices are shown working under severe service conditions. The "Electrocurl" is being demonstrated by an expert hair dresser, and any lady so desiring may have her hair dressed in becoming style free of charge.

Vulcan "Electric High Temperature Soldering Tools" are being used on work of all kinds, both in their own booth and in that of the Commonwealth Edison Company. On account of their high speed and ease of operation the Edison Company are using them to manufacture many of their souvenirs. The Vulcan "Electric Marking Pencil" is shown for marking shipping cases, boxes, etc. This is another new application of electricity to heating, and practical demonstrations are being made on hard and soft woods. Red hot "Electric Branders" for wood, meat, leather, rubber and other materials are also shown in various styles and sizes, both as hand and power tools, and souvenirs are made on the spot with them. These souvenirs are of heavy paper, one of the most difficult kinds of material to brand satisfactorily.

Mr. H. H. Russell, sales manager of the Vulcan Company, is in charge of the exhibit and has several expert assistants. Mr. F. J. Holmes, president; Mr. G. W. Cravens, general manager, and other officers of the company are also present a large part of each day and evening.

## TRADE NOTES.

Keeler, White & Co. moved their office and warehouse from 854 Mission Street to the Roberts Manufacturing Co. building, 162 Minna Street, San Francisco, on February 1, 1910.

The U. S. Dredge Chinook, to be used by the River and Harbor Commission at the mouth of the Columbia river, is being overhauled in the yards of the Marine Iron Works at St. Johns, Oregon. A large part of the upper deck will be removed to decrease the displacement. New boilers will be installed. The contract aggregates $130,000.

C. D. Andrews, wireless operator, who returned from Tahiti on the steamer Mariposa, brought the information that C. A. Ducarron is making a good beginning with a three-kilowatt wireless telegraph plant, the first to be installed there. The French Government has promised aid in extending the chain of stations to Fanning Island if the promoter effects communication between Papeete and Moketa. Thence the cable will complete the chain of communication between the south sea islands and New Zealand.

For supplying the motor-driven pumps of its municipal water filtration plant, the city of Cohoes, N. Y., has installed two Westinghouse gas engine driven, direct current generator sets, using producer gas as fuel. Both engines are of the three cylinder type 15x14 in. and develop 125 h. p. They are direct connected to two 75 k. w. 125 volt Westinghouse direct current generators. The output of these machines furnishes power for the motors driving the pumps of the city water supply, besides several other small motors about the plant, and the local lighting. The producer gas for this installation is derived from two 125 horsepower J-25 Westinghouse gas producers. The use of the gas producer in connection with the gas engine in a small plant of this kind is found to secure many advantages of economy, efficiency and ease in operation, over the equivalent combination of boilers and steam engines. The large number of such gas producer plants which have been installed in this country attest the increasing popularity of this modern type of power plant.

The Pelton Water Wheel Company of San Francisco report the sale of two Pelton-Francis horizontal turbine water wheels, frontal type, cylindrical encased, to the Washington Water Power Company, Spokane Falls Plant. Each turbine develops 1300 h. p. at 300 r. p. m. under an effective head of 65 ft., they being direct connected to alternators. The turbines are of unique design and consist of two approximately 36 in. runner to each unit, double draft tubes being employed together with two relief valves. The latter are of the Pelton mechanically operated type provided with adjustable oil by-passing devices so that the relief valves slowly close after the pipe line pressures have been restored to normal, incident to severe load changes. Both main bearings for each turbine are situated outside of the water chamber and are readily accessible for inspection, in fact all of the gate mechanism is situated on the exterior of the turbine casings. Owing to existing foundations in the power station, the Pelton Company's standard design was altered to suit same.

# NEWS NOTES

## FINANCIAL.

EL CENTRO, CAL.—The Board of Trustees has passed an ordinance calling a special city election to vote water bonds.

SAN BERNARDINO, CAL.—For the purpose of making improvements in a large tract of land in West Rialto the Fontana Water Company has voted a bonded indebtedness of $250,000.

CATHLAMET, WASH.—The City Council has passed a resolution providing for the construction of a system of waterworks and providing for the issuance of warrants to secure money for the payment of the same.

PASADENA, CAL.—Failure to secure the necessary two-thirds majority vote defeated the $1,000,000 water bonds $200,000 improvement bonds which were submitted to the people at the election January 27th.

NEWPORT, CAL.—Sealed bids will be received by L. S. Wilkeinson, city clerk, up to February 21st, for 40 bonds, $1000 each, known as municipal waterworks bonds, and 25 $1000 bonds, known as municipal light works bonds; both issues drawing 5 per cent interest.

COTTAGE GROVE, ORE.—Having found it impossible to sell the $100,000 five per cent water system bonds at par, there is a probability that the municipal council will renew its efforts to provide this necessary improvement by beginning over again. S. A. Kean & Co. of Chicago were the only bidders on the bonds.

SAN FRANCISCO, CAL.—The Russian River Light & Power Company has filed articles of incorporation with the county clerk. The corporation has an authorized capital stock of $300,000, divided into shares of $100 each, one share each being subscribed by the incorporators, J. E. Bennett of San Mateo, H. C. Eastman of Los Gatos, N. M. Twomey of San Francisco, E. R. Hough of Kentfield, L. R. Dickey of Alameda.

OAKLAND, CAL.—The People's Electric Light & Power Company has voted to issue bonds to the extent of $250,000. The bonds are to be 30-year 5-per-cent paper, to be dated July 1st, and are to consist of 125 at $1000, 200 at $500 and 100 at $250. In a statement of the original bonded indebtedness, the capital stock is given at $500,000, of which $300,000 is common and $200,000 preferred stock. All of the common and none of the preferred stock has been subscribed for. The officers of the company, which filed articles of incorporation two months ago, are: President, D. U. Toffelmier; Secretary, C. L. Best. The other directors are: J. H. Hornung, A. C. Sprout, E. W. Crozer and W. H. Spaulding. The purpose of the company is to establish a distributing plant near San Leandro.

SACRAMENTO, CAL.—With the filing of articles of incorporation by the East Sacramento Water Company it is announced that the board of directors of the company will meet next Tuesday for the purpose of completing plans for the coming year, select the district in the eastern limits of Sacramento upon which the company will first operate, take steps to apply for a franchise and decide on the size and kind of buildings which are to be erected at the water plant site. The directors are: H. J. Gothe, G. P. Beere, H. A. McClelland, H. Taubner Goethe, Thomas Oates, Peter Zingg and Albert Elkus. The capital stock is $205,000, and the principal place of business is Sacramento. It is the purpose of the company to supply water, gas and electricity for use in Sacramento county, particularly that section east of, but excluding this city. It is probable that Elmhurst, a new tract opened east of this city, will be the first to be supplied.

## TRANSMISSION.

KENNETT, CAL.—Electric power is to be used at the Uncle Sam mine, which is now operated by I. O. Jillson and J. A. McIntosh, with L. C. Monehan in charge as superintendent.

SPOKANE, WASH.—Bids for two transformers for use in the up river pumping station have been opened by the board of public works as follows: General Electric Company, $8200; Westinghouse Electric Company, $7175; Allis Chalmers Company, $6710, and Dixon & Kimmel, $7095.

RED BLUFF, CAL.—A notice has been filed in the county recorder's office by W. F. Luning, who lays claim to 12,000 inches of water in Hill Creek to be diverted near the corners of sections 21 and 22 in townships 27 north, range 2 east. The water is to be used for generating electric power.

FRESNO, CAL.—William S. Douglass and C. M. Russell have appropriated the water flowing in Fish creek at or near 6-5-27, four miles above its mouth to the amount of 1200 second-feet. A diverting dam is to be built, the water will pass through a tunnel 8x7 feet and three and half miles long.

LAIDLAW, ORE.—H. H. Humphrey of Kennewick, Wash., and Mrs. Carra Kirkham-Swafford have bought the two Awbrey Falls and the B. F. Nichols Falls on the Deschutes river close to Laidlaw ,the consideration for the power site being $50,000. The purchasers intend to develop the water power of the falls, which is estimated at between 40,000 and 50,000 horsepower.

PACHUCA, MEX.—A concession has been granted to Lic Alonso Mescal y Pina for the utilization of the waters of the Lake of Metztitlan, State of Hidalgo, for the generation of electric power. The concession also includes the drainage of the lake. A company to take over the concession will be styled as Empress Irrigation de la Vega de Metztitlan, Estado de Hidalgo.

EUREKA, CAL.—Surveyor J. N. Lentell has filed water appropriations as follows: 300 inches in a creek at crossing of Mountain View-Lone Star road near McBride's; 300 inches in a creek through Sec. 5, 3 N., 3 E., ¾ of a mile from McBride's gate; 300 inches in a creek in SE. ¼ of SE ¼ of Sec. 30, 4 N., 3 E., and 200 inches in Mad River about 200 ft. below the mouth of Bug creek. He plans to develope electric power for use in this city.

TACOMA, WASH.—Sealed proposals will be received at the office of the Commissioner of Public Works till February 21st for constructing the headworks and tunnel for a hydro-electric power plant on the Nisqually river, work to consist of a concrete diverting dam, intake and channel, with necessary screen and gates, and a concrete lined tunnel 10,015 feet long. Plans may be obtained from the office of the chief engineer, Tacoma, upon depositing $30. The estimated cost of the work is $657,575.

MANTON, CAL.—Notwithstanding the fact that the Northern California Power Co. laid off over 500 men here when the snow began to fly, it still has 350 men on its Manton pay roll. Most of these are at work on the tunnels through which water will be conveyed to the power plant at Inskip. The water will pass through four tunnels, the longest of which is 4300 feet. Another tunnel will be 1500 feet in length. The power plant at Inskip is rapidly approaching completion. All the machinery is on the ground and much of it is in place. When the weather moderates and a full force of men is at work again it will only take about a month to put everything into shape for starting the plant.

## TELEPHONE.

SAN FRANCISCO, CAL.—The Home Telephone Company has officially announced the opening of long-distance service between San Francisco and Oakland.

MODESTO, CAL.—J. C. Davis having petitioned the Board of Supervisors to erect and maintain a telephone line along the Maze road and said Board being fully advised in the matter, orders that said petition be granted.

YREKA, CAL.—The Supervisors have ordered that petitioners asking for permission to erect a telephone line between the Klamath Hot Springs and the Con Malloy ranch on Willow creek, be granted permission. The line to be known as the Ager, Hornbrook and Bogus Telephone Line Co.

LOS ANGELES, CAL.—Three dangerous railroad crossings on Aliso street and on either side of Los Angeles river bed are to be protected with electric alarm bells according to present plans of the Board of Public Utilities who have recommended to the City Council an ordinance providing for the installation of bells.

PORTERVILLE, CAL.—The old telephone line purchased several months ago from the Sunset Company by J. C. Danner of White River, and which is being replaced with a metallic circuit phone line, has been purchased by farmers of the Bear creek and Poplar districts. A. J. Saladay and H. S. Bachman are financing the deal.

OAKLAND, CAL.—Lincoln Park will be the location of the new building to house the department of the fire alarm and police systems of Oakland, under an expenditure of $45,000, as authorized in the bond issue, providing City Attorney J. W. Stetson finds no legal obstruction to the terms of the grant to the city of Oakland of the park property. The Board of Public Works and the Board of Fire Commissioners have agreed upon the excellence of the site in respect to proximity to the business district and the present system of cables, and it is proposed to erect a one-story structure of concrete.

OAKLAND, CAL.—The Home Telephone Company of Oakland intends to spend $500,000 in the extension of its system to Alameda, according to the announcement of T. C. Craig, the local manager. A separate exchange centrally located in Alameda, a system of underground wires contained in damp-proof cables and one-party lines connecting direct with the switchboard will be the features of the system in Alameda. The main cables connecting with the Oakland office will be run under the estuary near the Webster street bridge, but will be sufficient in number to allow every person securing an Oakland, Berkeley or San Francisco number without loss of time.

## ILLUMINATION.

HALSEY, ORE.—Geo. Taylor of Eugene, is planning to install an electric light system here.

ELLENSBURG, WASH.—The power canal of the municipal light plant is to be enlarged with a view of improving the service.

WENATCHEE, WASH.—Plans are being considered by A. J. Linville and others of this place for building an electric railway system to serve this place and the county as far as Leavenworth.

KALISPELL, MONT.—It is announced by J. A. Edge, president of the Whitefish & Poison Electric Railway Company, that a line will be surveyed at once for connecting the Northern and Southern ends of the county.

PHOENIX, ARIZ.—The Southside Gas Company has awarded a contract for the construction of a gas plant here to E. A. McGillivery of Los Angeles. The cost of the plant will be between $35,000 and $50,000. It is to be completed within four months.

IDAHO FALLS, IDAHO.—It is reported that the holdings of the Idaho Power & Transportation Company have been disposed of to the Byllesby Company of Chicago and it is stated that this company will begin heavy improvements at an early date in connection with the construction of electric roads, etc.

STOCKTON, CAL.—The farmers in the district comprising French Camp, Lathrop, Manteca, Ripon, Atlanta and Escalon have formulated a plan to secure electricity to run their irrigating plants and for lighting purposes. An enthusiastic meeting was held recently at Manteco, when a committee consisting of C. I. Salmon, Charles Brignoli, D. O. Castle, J. S. Moulton, J. N. Leighton, and I. Miller, which had canvassed the district reported that 1.095 horsepower had been conditionally pledged.

GEORGETOWN, WASH.—The Seattle Lighting Company has completed the purchase of property owned by the Hofius Steel and Equipment Company and will begin the erection of a sub-station including a large gas holder with a capacity of one million cubic feet and a two-story office building within the next sixty days. The expenditure for the holder will be $125,000. Five miles of mains will be laid here, while South Park, Youngstown and Rainier Valley will be served from this point.

## TRANSPORTATION.

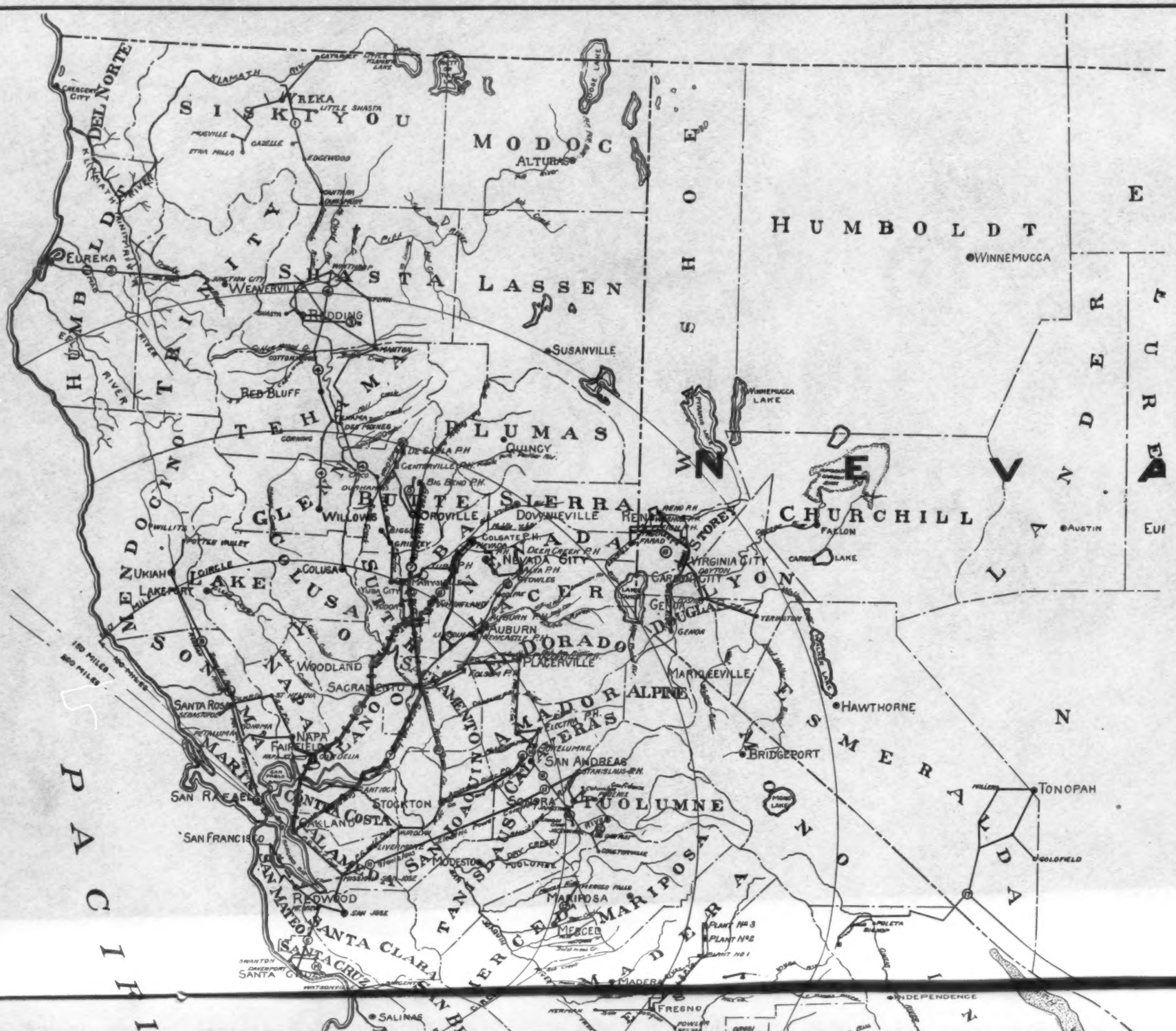
FULLERTON, CAL.—Between 25 and 30 carloads of railroad building material is being unloaded in La Habra valley and is to be used for the extension of the electric line east toward Olinda and Yerba.

EUREKA, CAL.—Estimates made on the cost of constructing a proposed electric railroad between Eureka and Redding or Red Bluff place its cost at $7,000,000. According to E. E. Skinner of the committee of ten Eureka business men now investigating the proposition, the building of the line is perfectly feasible.

ALAMEDA, CAL.—The ordinance granting the Southern Pacific Company a franchise to construct and operate an electric line from the High bridge to the loop in the east end has been given its final passage. The railroad company is to run trains from the lower part of the county through Alameda to the local mole and the above mentioned franchise is for a part of this system.

SACRAMENTO, CAL.—Two propositions for an increase in salary have been submitted to the local Street Railwaymen's Union by the Sacramento Electric, Gas & Railway Company, which were sent at once to the International President for approval. The substance of the increase is a raise of about 2c per hour. Men employed for the first year as motormen and conductors receive 27c an hour now, two years 28c, three years 29c and all over four years 30c. The increase means about $5 a month more to the street car men than they are receiving at present.

BERKELEY, CAL.—Work is being rushed on the S. P. electric system which completes the Berkeley loop system in this city. The tracks have been laid on Main street and the street work is now under way. Attorney Hobbs for the S. P. Company was before the Trustees last week with the request that the work being done in completing the street in the hands of the city and the land companies be expedited as far as possible. The two lines from the extension of the Shattuck avenue line in Berkeley and the extension of the California street line have already been pushed into Northbrae and Berkeley Heights and the lines of rails are converging toward this city toward Main street. The Ninth street line is soon to be connected, to connect with Jackson street in this city. There is a prospect, according to S. P. officials of the roads being ready for operation in 12 months from the present date.

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—TRANSMISSION SYSTEMS—
—OF—
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LEGEND
SINGLE CIRCUIT
DOUBLE CIRCUIT-SINGLE SUPPORTS
DOUBLE CIRCUIT-DOUBLE SUPPORTS
POWER HOUSES
① SISKIYOU ELECTRIC POWER CO.
② HUMBOLDT GAS & ELECTRIC CO.
③ NORTHERN LIGHT & POWER CO.
④ NORTHERN CALIFORNIA POWER CO.
⑤ ORO WATER, LIGHT & POWER CO.
⑥ PACIFIC GAS & ELECTRIC CO.
⑦ GREAT WESTERN POWER CO.
⑧ TRUCKEE RIVER GENERAL ELECTRIC CO.
⑨ SNOW MOUNTAIN WATER & POWER CO.
⑩ AMERICAN RIVER ELECTRIC CO.
⑪ STANISLAUS ELECTRIC POWER CO.
⑫ TUOLUMNE ELECTRIC
⑫ AMERGED FALLS GAS & ELECTRIC CO
⑬ TUOLUMNE COUNTY WATER & ELECTRIC POWER CO.
⑭ COAST COUNTIES POWER CO.
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⑰ NEVADA-CALIFORNIA POWER CO
⑱ SAN JOAQUIN LIGHT & POWER CO.
⑲ MT WHITNEY POWER CO.
⑳ EDISON ELECTRIC CO.
㉑ POWER, TRANSIT & LIGHT CO.
㉒ PACIFIC LIGHT & POWER CO.
㉓ HOLTEN LIGHT & POWER CO.
PACIFIC OCEAN
SAN DIEGO
SANTA BARBARA
VENTURA
SAN LUIS OBISPO
MONTEREY
FRESNO
KERN
KINGS
TULARE
INYO
SAN BERNARDINO
RIVERSIDE
ORANGE
LOS ANGELES
SAN BE
SAN RIV
SAN